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A.M.A. ARCHIVES OF SURGERY

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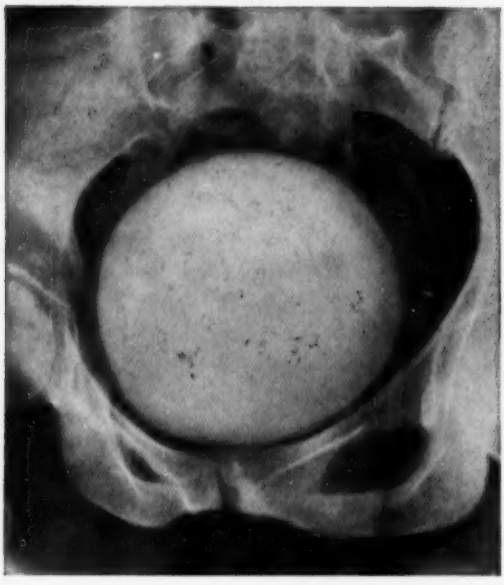

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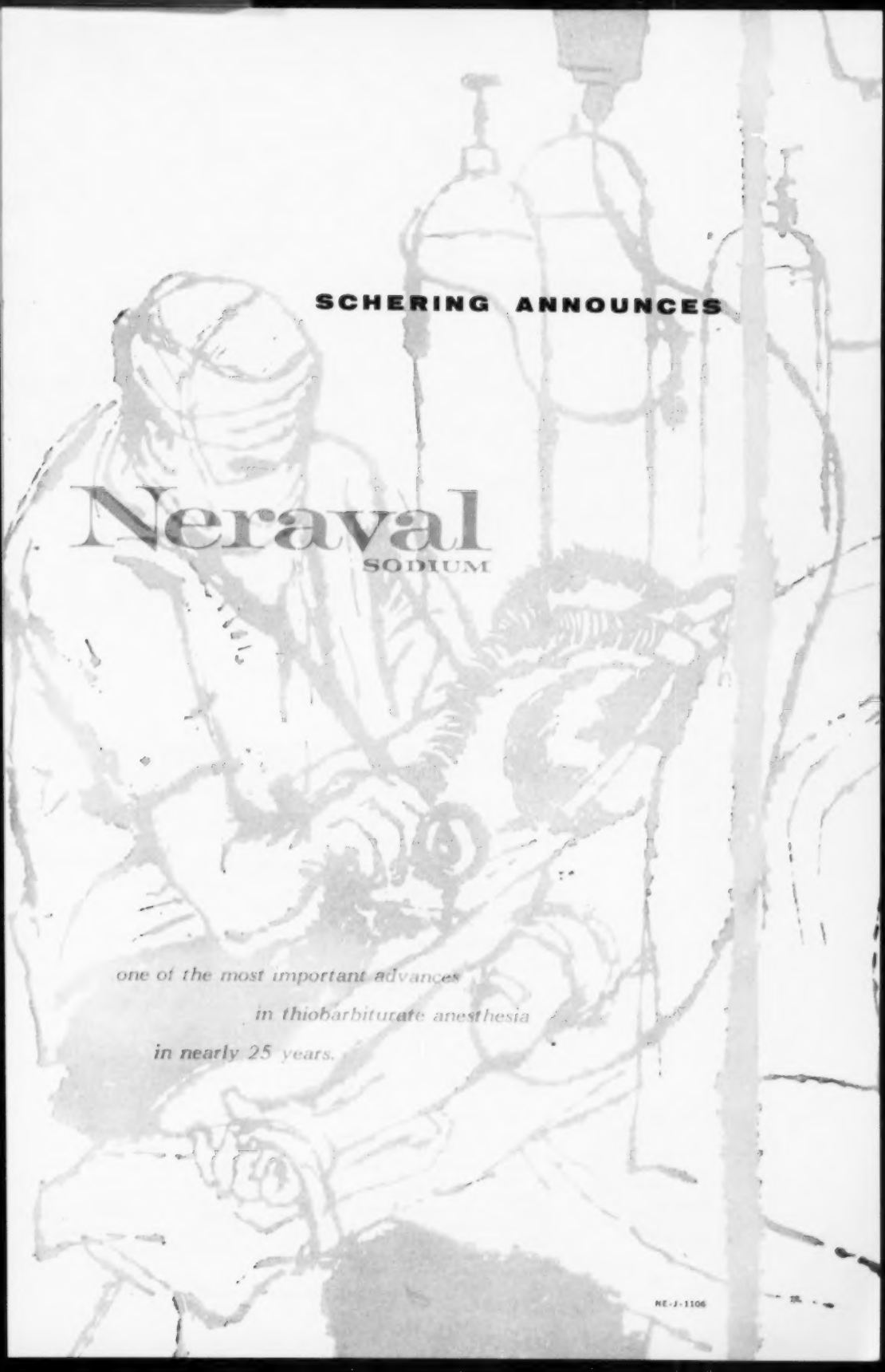
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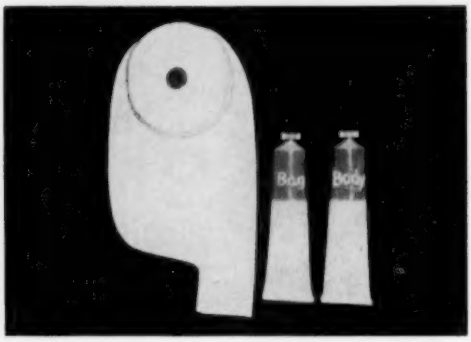

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A.M.A. ARCHIVES OF
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Of One Medicine, Nine Surgeries

CHARLES G. JOHNSTON, M.D., Detroit

The choice of a topic for a presidential address tends to become stereotyped in that such an address generally deals with the problems of the day against a backdrop of the past. This Association has had a brilliant past and at present is a virile, progressive, and withal a pleasant and friendly group. This Association has taken a positive stand for good surgery for 66 years and has been in the forefront of its advances as well as sharing in its problems.

The philosophy of medical education, both undergraduate and graduate, the relation of the surgeon to his patient, and the rise of specialism have been common themes for discussion. It is, therefore, with some trepidation that I discuss a subject which has been thoroughly discussed by others more capable than I. This subject has captured our attention for the past 20 years or more. Not only have new techniques been developed, which have resulted in operative procedures not before considered possible, but also changes have come about in organizational patterns and in consideration of ethical problems.

In relation to the latter, there has been some conflict within the medical profession, based, I prefer to believe, on differences in interpretation and opinion. The result has been an awakening of the conscience of surgeons to the evils of the division of fees and of ghost surgery. The condemnation of such practices is possibly based only on the proposition that each physician who cares for a patient is entitled to recompense from the patient and that the patient is entitled to know for what he pays and to whom. In such circumstances the choice of the surgeon can be based on consideration of obtaining the best service for the patient and on that alone.

It is changes in organizational patterns relating to surgical training programs and certification of specialists, which have caused much comment in surgical circles and have stimulated the question as to further changes and their possible effects on surgical practice.

The concept of specialization is not new. It is of interest to note that, in relation to the establishment of the first medical school in America, John Morgan felt constrained to discuss this problem. In his "Discourse Upon the Institution of Medical Schools in America."[1] Morgan outlined what even today are considered good principles of medical education, but these principles were not carried out until more than 100 years later. Specialization was not the common practice, as indicated by Morgan's arguments in its favor. Excerpts from his polemic, written in 1765, are worthy of quotation: "It will be readily acknowledged by every one that allows himself to reflect upon it, that some regulation in regard to a physician's attendance upon the sick is now become highly requisite. . . . . I am not urging these as arguments for a more

Presidential address read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

expensive practice, but for an improvement of it, by separating physic from surgery and pharmacy, which I think incompatible with them."

Morgan's argument is directed more to the ease, comfort, and income of the physician than to the advantages of specialism to the patient. He states: "What reasonable objection can be then offered against an improvement in the present method of the practice of physic, which, to a man in great business, is by every one allowed to be the most slavish profession known in this part of the world.

"Every mechanic has a certain portion of time allotted to him for a relaxation from business, and for the enjoyment of social happiness. Physicians have next to none, but they are obliged to be at the call of the sick, every hour in the night as well as of the day.

"In the more laborious occupations of life, as in building a house or a ship, a great variety as well as a great number of artizans are employed, but all in different departments. In the less laborious callings we observe the like prudent regulations, thus in making a pipe, a button or a pin, a variety of hands, no less commonly than five, six or seven different artists unite their industry. By this means they finish more work in a limited time, and can afford to sell it at a cheaper rate."

The guild philosophy appealed strongly to Morgan. One more excerpt illustrates the place of the physician in the scheme of practice which he had learned in England: "It is not only expedient but necessary that a physician should have a general and extensive knowledge of the whole art, and be acquainted with the prinicples of every branch of his profession. Thus the general of an Army should be acquainted with every part of military science . . . but there is no need that he should act as a pioneer and dig a trench. Where a proper subordination is wanting, there is a perversion of all practical knowledge. No more than is a physician obliged, from his office, to handle a knife with a surgeon; to cull herbs with the botanist; to distill simples with the chymist; or compound drugs with the apothecary."

The march of specialism has advanced a long way since colonial times. Morgan's concepts of medical education have been generally accepted and apply to physicians and surgeons alike. Internists have not felt the impact of specialism as has the surgeon. Areas of special interest and of sufficient scope to have associations and journals devoted to the subject, e. g., allergy, diabetes, and cardiology, are still considered part and parcel of internal medicine. Less extensive areas of surgical interest and with less evidence of organization have requested Board status.

Specialization has arisen from the rank and file of doctors, not because of a known need, public demand, or planned arrangement—specialization arose because of the interest and ability of the doctor in special problems and a recognition of his ability by his colleagues. The original specialists were good doctors first and were specialists by force of circumstance. Mackenzie was recognized in his time as expert in heart disease because of his interest and skill in the diagnosis and treatment of cardiac disorders and for his clear description of his cases. Mackenzie is today recognized as the father of modern cardiology, was respected in his time for his ability by his confreres, but actually was a beloved family doctor to his patients.[2] S. Weir Mitchell is considered by some as the father of clinical neurology. He was a general internist. J. Marion Sims was a general surgeon,[3] recognized in his time for the surgical treatment of vesicovaginal fistulae. Hugh Young, was a resident under Halsted, was recommended for a professorship in pathology, and was placed in charge of urological problems by Halsted one year after he was assigned to the urological ward. While on the urological service, he became interested in the bacteriology of genitouriniary cases, even though his main experience and interest were in general surgery.[4] Harvey Cushing and Charles H.

Frazier, who fathered neurological surgery in America, were general surgeons. These are but a few of the possible illustrations of the fact that specialization grew because of the recognized ability and interest of good, well-grounded doctors. There are in all surgical specialty fields today leaders in their specialty who were trained as general surgeons, attained high recognition as such, and later on became nationally recognized in special fields. There are many such among the membership of the Western Surgical Association today. The specialty certification of such men was not written on parchment, but in the high respect of their confreres for the excellence of their work in the special field of their interest.

While it may seem that surgical specialties are based only on differences in technology, this cannot be so if surgery is to continue as the servant of the sick. The surgical specialist is, and must remain, a doctor who is capable of understanding the problems of his patient as a whole individual. Technology is not enough, and a specialist must be more than nimble fingers applied to routine procedures. Nor can the specialist limit his education to segmental medicine.

One of John Morgan's arguments for specialism in colonial times related to the advantages of the division of labor as practiced by artisans of his time. Our profession today is not generally inclined to compare the advantages of surgical specialism with the modern movement of specialization among workmen. I am not sure that the public does not have a tendency to do so. Our hours are not limited, and we do not have the type of control which prevents us from using the most advantageous facilities to get our work done! There can be no parallelism in our philosophy of specialism and that of trade unionism. We deal with human life and not machines.

Were it not for the fact that there are young men who enter medicine with the idea that the technical aspects of surgery are all-important, there would be little reason to discuss problems of the surgical specialities.

The "Directory of Medical Specialists," [5] Volumes 1 to 6, is a large book with a lot of names and some interesting material relating to each specialty. A comprehensive picture of the various Boards described therein cannot be obtained by reading one volume. By reading the descriptive material through the various volumes, changes are noted which indicate that the Boards are not static. Changes are observed in objective, scope of the specialty, content, and extent of training requirement. Some Boards are restrictive, threatening revocation if the diplomate engages in the care of types of illness not specifically prescribed. For instance, the removal of an appendix in a man is forbidden; in a woman it is quite all right. Anatomically, physiologically, and, in fact, surgically, there is no difference. There is noted overlapping of the areas claimed by the various Boards. Surgery of the head and neck seems to be in the province of the general surgeon, the plastic surgeon, and, since the advent of antibiotics, the otolaryngologist. While not listed in the Directory, this same area has lately been claimed by the dentists in some localities. Training outlines are set for the trainee, but in instances where the specialty is extended by edict, there is no designation as to how the teacher is to obtain training sufficient to teach the resident. The head and neck are not the only area in which there is overlapping of fields, or in which invasions have been made. While the Advisory Board for Medical Specialists might be considered as the UN of the Specialty Boards, actually each Board maintains sovereignty.

Reading the Directory ad seriatim reveals that the American Board of Surgery has in later editions indicated that general surgery is indeed general, and it is not concerned with measures to gain special privileges in the practice of surgery; nor does it define requirements for hospital staff membership. This lack of concern on the part of the Board unfortunately has not prevented others from concerning themselves with such matters, as is evident by the inclusion of this statement.

Jurisdictional disputes are common, and hospitals have attempted to classify what can and cannot be done on the basis of Board certification and, where there is overlapping of claims on anatomical segments, have resorted to compromise by requiring both Boards to be represented on the operating team. This sometimes is difficult, since in some areas under dispute there seems hardly to be room for a representative of one Board.

One other feature which militates against universal and wholehearted acceptance of Boards by members of the medical profession is the inference of monopolistic concepts. While most assert that their interest is in providing adequate training for the specialist, there is at least one Board which describes as an objective "to prevent unqualified persons" from practicing the specialty—the qualifications being presumed to be Board membership.

It is difficult to realize that, while internal medicine is still internal medicine, surgery is now nine different, separate, and distinct programs. This number of surgeries does not include thoracic surgery, which actually is considered as an extension of general surgery. This latter arrangement is similar to the status of surgical specialties when the specialties were born, i. e., the specialist was a good general surgeon plus something additional.

Minimal requirements for formal surgical training vary widely among the surgical specialty boards from one year for gynecology to five years for thoracic surgery. Some of the Boards require a period of practice before the candidate is eligible for examination. Many incongruities relating to the Boards' regulations and philosophy are better presented by a retiring chairman of the Advisory Board for Medical Specialists,[6] as well as indicated by changes in the prospectuses of individual Boards.

Two important activities of the Boards are similar in broad generalities, even if varied in detail. The first is to determine by examination and other means competence of specialists desiring certification, and the second is to determine interest in training programs for the specialty. The first is difficult, as it gives no estimate of those not applying for certification, except by inference. The second has had a strong impact on graduate surgical education.

The American Board of Surgery was established in 1937. Since that time the interest in and development of training programs have been remarkable. Minimal standards have been established, which have eliminated some substandard programs, and others either will become better or also face elimination. This is a matter which could not be hastened, as hospitals require time to develop programs. The separation into Group I and Group II programs suggests that there are two types of surgical citizens, one set of rules applying to one group and one to another. This does, however, allow flexibility, recognizes that there is more than one acceptable way of training a surgeon, and does permit time for hospitals to extend their programs. It is difficult, however, to consider such an arrangement as permanent.

The American Board of Surgery has always maintained that general surgery is general and requires candidates to have experience in caring for surgical problems of the whole patient. General surgery is not the surgery of what is left after surgical specialties have staked their claims. Were this so, there would be nothing left but the stomach, small intestine, spleen, liver, and pancreas. All too often surgeons who are interested in these areas are not too interested or able to provide training in the broader field of general surgery. This has resulted in residents who, after having spent long years in training in the surgery of limited areas,[7] find that they are poorly equipped to care for the ordinary needs of patients. The practice of farming out residents to other hospitals or other services hardly can be expected to make up this deficit, for all too often they spend only short periods on other services at an early period in their training. In this circumstance they get very little training, as they are usually no more than

interns on a service designed to train specialists in a limited specialty.

There has been concern about the limitation of broad background training for surgical specialists. This is to an extent true also of general surgery in hospitals with many separate specialty departments. There are a limited number of hospitals which can arrange for broad general surgical training under ideal conditions, as strict departmentalization with separation of programs is common in most larger hospitals.

Some surgical specialty boards have recognized the need for general surgical training and have added one year of general surgery as a requirement. This is a step in the right direction but really adds little. The trainee who tries to obtain one year of general surgery has difficulty in obtaining this in a good institution, since such institutions are generally geared to a graduated four-year program. The candidate who is getting a year of general surgical requirement does not generally make a satisfactory general surgery resident because he is usually not too interested in what he is doing, considers it as a barricade to his limiting his scope of interest, and of little importance except to obtain credit. Even were a one-year program feasible to provide, it is not likely to do much toward providing a good broad background for the trainee. This period is too short. This is especially true in general surgical programs which are limited by strict departmentalization. Specialty departments would do well to recruit their residents from men who have finished general surgical programs. This should not be difficult, especially where there has been arrangement for these men to have had contact with the specialty, so that they have an opportunity to develop an interest. This would more nearly approximate the background of the origins of the specialty and provide outstanding practitioners. Surely the addition of general surgical requirement bespeaks an interest in recapturing some of the beginnings which made the specialty.

In the development and application of a program which has brought about rapidly moving changes in so fundamental a matter as the training of the surgeon, it would be strange if adverse criticism were not evident. It is about twenty years since the American Board of Surgery was organized. This and other leading surgical associations have sent outstanding representatives who not only have shaped the policy of the Board but have carried out the arduous work of examinations. This has been an enormous task carried out by conscientious, devoted men. It is a tribute to the wisdom and energy of these men that such progress has been made by the Board. Much of the criticism of the American Board of Surgery has had nothing to do with the principles or objectives of the Board. An example of this has been the use of Board certification by hospital staffs as a basis to deny privileges to some of their members, regardless of the actual reason.

The development of adequate residency programs in hospitals has been a natural sequence of Board activity. Surgery must be taught in hospitals. The supposition that the medical school can carry the educational load in graduate surgery in spurious. Even where the medical school and the hospital are in close proximity, the medical school can supply only supplementary aid. Basic sciences, which is listed by some Boards as a six months' training requirement, becomes an evanescent something, since it involves five different disciplines. In any one of these, six months' training would be minimal for a reasonable grasp of the subject. It is not possible for every surgeon to be an expert in all these subjects. The surgical teachers must have a sufficient grasp of these subjects to relate them to surgical problems. Fortunately, there are surgeons in many training programs who have interest and special training in one or another of the basic sciences to guide the trainee. Training programs where there is the good fortune to have specialists in these fields from departments in medical schools to supplement the day-to-day teaching are fortunate but this is not possible in all. Surgery might well be considered as the application of the basic

sciences to the sick surgical patient, and it is therefore necessary that these fundamental aspects of surgery be considered throughout the entire training program.

Training in surgery cannot be standardized strictly. Minimum standards are one thing; detailed curricular schedules, rotation, and transfers must fit the local situation. Fortunately, all surgeons are not poured from the same mold. Actually, good present-day surgical residency programs have much of the original preceptor concept. A qualified, interested teacher and an alert, enthusiastic, energetic student are a combination hard to beat, if adequate clinical cases are available. Better a limited clinical case load with a good teacher-and-student relationship than the converse. Techniques must be learned, but these are not so difficult to acquire as surgical judgment. Compassion for the sick must be transformed into doing the best possible for the patient. The student cannot consider his residency as an arrangement for providing as much information and skill possible, with the least concern and expenditure of energy or thought on his part, tolerating the ordinary tasks of patient care for the opportunity of learning technical details at the operating table. The preceptor must not be so concerned with keeping the various segments of his program manned that he forgets his role as a teacher. We have not as yet evolved a surgical curriculum which can better the arrangement of a qualified teacher interested in the development of the young surgeon with an alert, enthusiastic, imaginative pupil who shares the work of the teacher, his joys or heartaches which come with their joint successes or failures.

The evaluation of the effects of our present system which has been stimulated by the ultimate goal of Board certification, can best be made on the basis of the products of the system. Even with the limitations mentioned above, we can be proud of the young surgeons of America, the product of this system.

In our zeal for programming we have lost some of the essentials which have made our profession great. The public may submit to inadequacies in relation to plumbers, electricians, and carpenters due to specialization; it is unlikely long to tolerate limitations in surgical care. The fact that a plumber must call in a carpenter to do a simple job that he could do as well himself may be tolerated, but a patient is not likely to tolerate a doctor who must refer him to another for simple matters which ought to be common medical ground.

There is but one surgery. It has one common heritage. It cannot become irrevocably segmentalized. The nine surgeries must become one to whatever extent the interest of the patient dictates. The changes from year to year which are evident in individual rulings of various Boards are an indication that the Specialty Boards are sensitive to the fact that the system is not perfect and is possible of progressive changes. Surely, the background and training of the surgical specialist ought to be equal to, if not better than, that of the general surgeon. It was once, and it seems a reasonable goal to attain again.

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Bridging of Laryngopharyngeal and Upper Cervical Esophageal Defects

Use of Artificial Materials

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Cancers arising in the laryngopharynx, extrinsic larynx, and upper cervical esophagus constitute difficult therapeutic problems. The main method of treatment in the past has been irradiation therapy. A survey based on reports from eight different world radiation centers [1] indicates that, when total experiences are reported, the "world cure rate" is found to vary from a low of 3% to a high of 14% with a mean figure of 7.6% (Table 1). Cancer therapists are now turning with greater frequency to surgery to improve these results. With the surgical advances of the last two decades, it is now possible to perform the extensive operations required for extirpation of these tumors with a reasonable morbidity and mortality. Preliminary reports from centers dealing with these operations indicate an improvement in both the over-all survival figures and the palliation received when compared with irradiation.

Physiologically, patients will tolerate almost any degree of soft-tissue sacrifice in the neck as long as both carotid arteries and one vagus nerve are left intact. More practical questions are how much soft tissue can be removed and (*a*) still leave the patient in a condition that makes life worth living, (*b*) can still be carried out with a reasonable morbidity and mortality and (*c*) where is the point beyond which further removal and sacrifice of soft tissue still will not improve the long-term survival rates.

It is perhaps worth emphasizing again that the crippling part of these operations is the loss of the larynx. The additional removal of parts of the pharynx and upper cervical esophagus and the neck dissection do not add materially to either the risk or the permanent loss of function. Treatment with irradiation carries with it the rosy dream of eradication of the tumor with preservation of the larynx, but the dream is only rarely realized. Sufficient numbers of patients have now been treated with surgery and followed long enough to show a material increase in salvage with this newer attack.

In this type of surgery, one of the limiting factors is the restoration of pharyngeal-esophageal continuity upon completion of removal of the tumor. This paper will discuss methods of accomplishing this when such a large amount of tissue has been removed that primary closure cannot be obtained and will also attempt to answer the question as to whether this additional removal of tissue which requires an artificial closure pays off in terms of increased long-term survivals. A total of 51 patients from the combined experience on the General Surgical Service at George Washington

TABLE 1.—*Results of X-Ray Treatment of Cancer of Laryngopharynx* *

Country	Cases, No.	5-Yr. Cures, per Cent
England (Cade 1949)	44	7
Finland (Stipilä 1949)	172	8
France (Coutard-Baclesse 1949)	425	6
Germany (Glauner 1949)	112	3
Ireland (Douglas 1950)	77	6.5
Norway (Rennaes 1949)	84	7
Sweden (Jacobsson 1950)	84	14
London—Royal Cancer Hospital (Lederman 1951)	162	10

* After Jacobsson [1].

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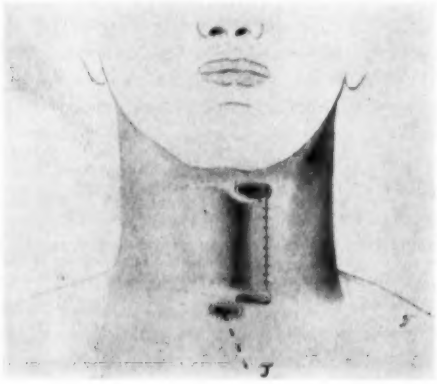
University and the University of Colorado School of Medicine are available for analysis. Forty patients were closed primarily, and eleven required artificial closures.

Historical Review

Early efforts to remove these cancers concern the development of techniques for removing the larynx. In 1873 Billroth [2] performed the first laryngectomy in humans. The wound was left open in the hope that in healing the pharyngostome would close and the tracheostome remain open. The aspiration of saliva and liquids into the lungs that must have occurred can be appreciated, and this method could hardly be termed a success. In 1892 Solis Cohen,[3-5] assisted by Prof. W. W. Keen of the University of Pennsylvania, reported two cases of total laryngectomy in which the principle of diverting the trachea stump to the skin was used. This forward step placed the operation on a practical basis and remains today an integral part of the procedure.

When the lesion extended beyond the confines of the larynx proper onto the adjacent pharyngeal wall or the base of the tongue, it was considered completely inoperable even after the technique of total laryngectomy had been perfected. In 1908 Von Hacker [6] reported an operation on a patient (Fig. 1) suffering from cancer of the hypopharynx in which a total laryngectomy and partial pharyngectomy were carried out, and the continuity of the alimentary tract was reestablished in stages by means of a long oblong flap of skin and subcutaneous tissues taken from the neck. This type of procedure has since become more popularly known as the "Wookey procedure," and its details have been published many times. It is subject to the disadvantages of not removing the cervical lymph nodes or being difficult to complete if a neck dissection is carried out, because the required incisions interfere with the neck flaps that must be used for reconstruction.

Fig. 1.—Schematic illustration of the first stage of esophagoplasty, namely, building the posterior esophageal wall by covering the wound with a rectangular flap with a pedicle on the right side of the neck. *T*, trachea. (In the drawing, for greater clarity, the esophagus is shown as divided at a level lower than the pharynx.) (From von Hacker,[6] *Archiv fur klinische Chirurgie*, Springer-Verlag.)



Failure to provide for removal of the lymph nodes places serious limitations on the expectation of cures. The inaccessibility of these tumors permits them to gain a large size before the patient has any warning of their existence and is reflected in the fact that the initial symptom in about one-third of the cases is a cervical metastasis; the actual area of the primary tumor as measured on our surgical specimens was 11 sq. cm. It is clear, therefore, that curative attempts must be aggressive attempts, and this today has come to mean total laryngectomy and partial pharyngectomy or esophagectomy combined with neck dissection even in the absence of clinically involved nodes.

In the past decade, Grimes and Stephens,[7] Martin,[8] ourselves,[9] and others have reported on these more extensive procedures. No author has yet released a statistical report showing an improvement in the five-year absolute cure rate, but such evidence is forthcoming shortly. Martin,[10] for example, states that the 12% cure rate achieved on the Head and Neck Service at Memorial Hospital has more than doubled (30%) following a change in that clinic from radiation therapy to laryngopharyngectomy with neck dissection.

Continued exploration of the value of surgical techniques in the treatment of these lesions seems justified, therefore, both on the basis of the above facts and on the basis that the end-results with irradiation seem to have reached a plateau. In our own experience, 11 cases were treated with x-ray without control of the disease in any instance.

Encouraged by the apparent improvement in both cure and palliation resulting from the switch from x-ray to surgery, we naturally wondered whether extending the operation even further, though it be at the expense of not having enough tissues for primary closure, would improve salvage even further. To us it seemed that such efforts would be of value only if a method of accomplishing this in a single stage was developed. Edgerton [11] has already published one such scheme in which continuity was established by wrapping a free skin graft around a wire stent. Our efforts were directed toward using polyethylene, since in our experience, except where the skin graft was based on the firm prevertebral muscles, "takes" were very hard to achieve.

Experimental Laboratory Work

The practicality of artificial substitutes has been established by many different investigators. Their use in the reconstruction of pharyngeal or cervical esophageal defects had not been well worked out at the time when this project was undertaken. Exploratory laboratory procedures were therefore performed in order to work out the technical problems before application to humans was attempted. Klopp [12] reported earlier on this phase of experimental work in dogs. In these experiments polyethylene, both with and without skin grafts, was used to bridge complete and incomplete pharyngeal defects. In all these experiments the larynx was left intact. Complications consisted of aspiration of food into the trachea during the postoperative period, fistula formation, and strictures.

A comparable situation does not exist in humans when one is attempting to remove cancers of the laryngopharynx inasmuch as it is seldom possible to preserve the larynx, since it is so frequently involved with tumor. Nevertheless, the question still remained to be answered as to how much of the cervical esophagus could be removed and reconstructed with a prosthesis and still maintain function of the larynx. With this objective in mind, complete sleeve resections of the cervical esophagus were performed and continuity established by polyethylene in eight dogs. The results can be summarized as follows. Sleeve resections carried out in the esophagus at a point well away from the larynx appeared to be tolerated. As one approached the larynx, however, complications appeared. When the upper end of the plastic prosthesis was placed within 2 cm. of the cricopharyngeus muscles, difficulties in swallowing and frequent aspiration of food into the trachea immediately occurred. Furthermore, this situation never completely corrected itself even after the postoperative edema had subsided, and such animals ultimately died from pulmonary sepsis.*

All other animal work, however, indicated that the polyethylene tubes were adequately tolerated by the tissues, that within 48 hours an airtight seal had developed around the anastomotic lines, and that, although the prosthesis itself might subsequently dislodge, this did not occur until a fibroepithelial conduit had formed around it, so that the animals were still able to eat. Strictures occurred in all animals but not to a degree

* The clinical counterpart to this experiment was applied in one of our human patients. This person had a malignant melanoma in the upper cervical esophagus, and an effort was made to remove this segment of the esophagus and to preserve the larynx while restoring the continuity with a polyethylene tube. Unfortunately, the amount of esophagus which had to be sacrificed in order to circumvent the primary malignant melanoma necessitated the upper end of the plastic prosthesis being in the region of the cricopharyngeus muscle. This patient never learned to swallow and 17 days after the operation, after having had repeated episodes of aspiration into her tracheal tree, died rather suddenly from a combination of what we interpreted as being pulmonary sepsis, laryngeal edema, and diabetes.

that could not be controlled by periodic dilatation. We therefore considered that enough experimental work had been carried out to support some hope that this scheme might be applicable to human beings.

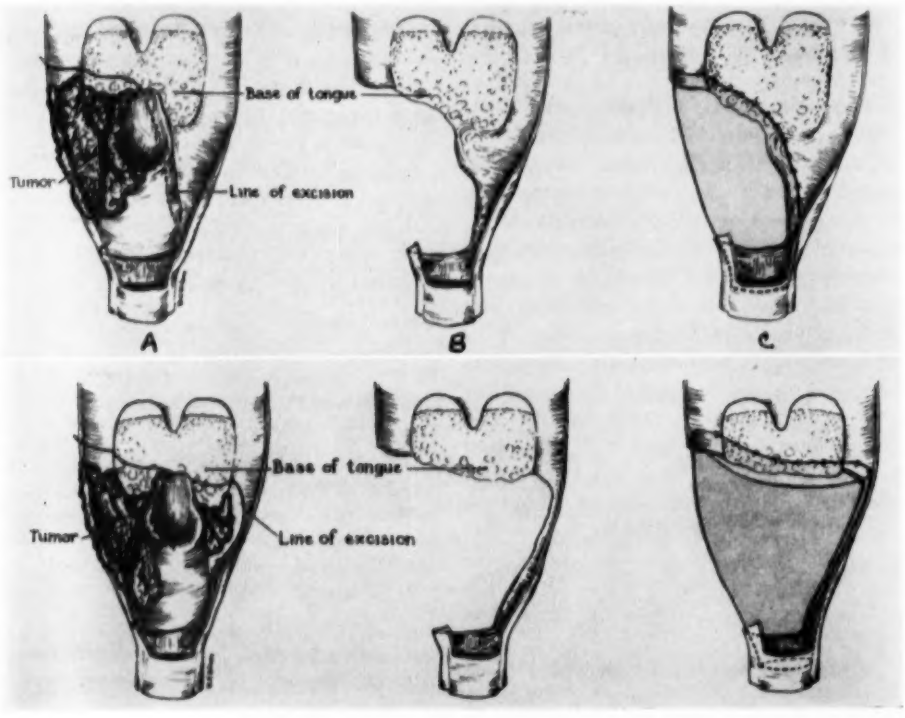
Restoration of Continuity with Polyethylene in Humans

Of a total of 51 patients receiving laryngopharyngectomy, partial esophagectomy, and neck dissection, there were 11 patients who had such extensive tumors that, following removal, no possibility of primary closure existed. In these cases continuity was established with polyethylene in every case. In the beginning skin grafts were used with the polyethylene stent, but our "takes" were so poor that it seemed they contributed little to the problem.

The prosthesis consisted of a cylindrical molded tube of polyethylene made by wrapping the film about a cylinder and fusing it with heat. The lumen was approximately 1.5 cm. and the thickness, approximately 4 mm. The prosthesis was cut to fit the defect, depending on whether a partial or a complete sleeve resection of the pharynx had been executed (Fig. 2).

The polyethylene was inserted inside the ends of the pharynx and cervical esophagus and sutured with interrupted mattress sutures. No effort was made to obtain a true watertight closure. After this had been done, available bits of muscle and connective

Fig. 2.—Artificial reconstruction of laryngopharynx and upper esophagus, diagrammatic views looking from behind forward. At the top, a partial sleeve resection of the pharynx is shown; below, a complete sleeve resection. *A*, tumor too large to permit primary closure following excision. *B*, defect, following neck dissection with total laryngectomy and partial pharyngectomy, too large for primary closure (divertation of trachea to skin is not shown). *C*, reconstruction with polyethylene sheets. This may be varied by using wire mesh or adhering skin graft, etc. (The trachea stump has been diverted to the skin.)



tissue, such as strap muscles or occasionally prevertebral muscles, were tacked down to support this "anastomosis" insofar as possible. A feeding tube was then passed through the nose to the stomach. The skin was then closed and held against the tubing by a large pressure dressing. The trachea, of course, was diverted to the skin at a separate point. The large pressure dressing was left in place for about one week, and pressure was maintained again with each dressing change for about two weeks.

Results

There was one operative death in this group, which resulted from hemorrhage from a large pharyngeal vein six hours postoperatively. Aside from this, the immediate results appeared satisfactory. Although the tubes and polyethylene sheets were eventually dislodged in 8 of 11 patients, they remained in place long enough for a serviceable conduit to form that served as a suitable channel for the ingestion of food. Fistula formation occurred in 5 of the 11 cases but closed spontaneously in all but one instance. As might be anticipated, the greater the amount of normal pharyngeal wall that could be left after removal of the tumor, the more successful the postoperative course, and, conversely, the more the removal approached a complete sleeve resection, the more frequently were fistula formation and stricture encountered.

These complications could be satisfactorily combated. However, as long-term follow-ups became available, one by one the patients developed evidence of the one complication for which no effective countermeasure exists, namely, recurrent cancer. At the end of three years only one patient of the group was still free of cancer. And at the end of the fourth year he too had recurrence (Table 2). One patient committed suicide seven months after the operation, when attempts were being made to reconstruct the pharyngeal defect after the prosthesis had been extruded through a large fistula that did not close spontaneously.

This discouraging long-term salvage rate contrasts sharply with that achieved in the group of patients where a primary closure was possible and where one out of three are alive and well after three years (Table 3). In these cases, of course, the tumor was less extensive. Neither from the point of view of palliation can much be said in favor of the artificially closed group. If one uses the duration of life after operations as a criterion of "palliation," the failures in both groups survived almost similar lengths of time (Table 4).

TABLE 2.—*Cancer of Laryngopharynx*
Closure with Artificial Substitutes

Case	Date of Operation	P.O. Fistula	Fate of Tube	P.O. Status	Remarks
1	7/15/49	+	Extruded through neck	DOD 6 mo. P.O.	Committed suicide
2	10/ 7/49	0	Remained in place	Operative death	Hemorrhaged 6 hr. P.O. from pharyngeal vein
3	11/18/49	+	Swallowed	DOD 11 mo. P.O.	Never swallowed satisfactorily
4	4/ 7/52	+	Swallowed	DOD 6 mo. P.O.	Poor palliation—difficulty in swallowing
5	4/17/53	0	Swallowed	DOD 15 mo. P.O.	Good palliation 1 yr.—swallowed well
6	4/22/53	0	Swallowed	LNED 3 yr. P.O.	Good palliation—still well & eating normally
7	11/ 2/53	0	Remained in place	DOCNED 7 mo. P.O.	Good palliation—death from CVA
8	1/19/54	+	Swallowed	DOCNED 11 mo. P.O.	Death from lung abscess & empyema
9	5/ 5/54	+	Swallowed	DOD 9 mo. P.O.	Never swallowed well—recurred within 2 mo. P.O.
10	1/ 5/54	0	Remained in place	DOD 2 wk. P.O.	Larynx left in & patient died—aspiration pneumonia, diabetes
11	2/15/54	0	Remained in place	DOD 11 mo. P.O.	Swallowed well until massive local recurrences

Key: DOD=dead of disease (cancer)
NED=no evidence disease
LWED=living with evidence of disease
DOCNED=dead of other causes, no evidence of disease.

TABLE 3.—*Cancer of Laryngopharynx*

Primary Closure vs. Artificial Closure
Three-Year Cure Rate

Primary closure	(40 cases)	35%	(14 cases)
Artificial closure	(11 cases)	9%	(1 case)

Comment

Very rarely, small tumors of the pharyngeal wall will be encountered that can be adequately removed with more limited operations (Figs. 3 and 4). As greater experience in the more extensive procedures has accumulated, a few little tricks in technique have been picked up which have raised the percentage in which primary closure is possible. For example, we now know that, if a closure which leaves a diameter of only 1

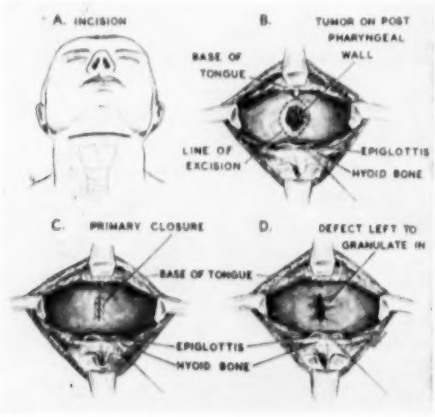
TABLE 4.—*Cancer of Laryngopharynx*

Primary Closure vs. Artificial Closure
Duration of Life in Treatment Failures

Primary closure	(26 cases)	9.8 mo.
Artificial closure	(10 cases)	10.5 mo.

cm. around a feeding tube can be achieved, this will work surprisingly well. Such patients have healed and have been able to take first liquid and soft food and have subsequently progressed to a normal diet without requiring dilatation. Most of the improvement in techniques pertains to minor but important variations designed to save more and more normal mucosa which can be subsequently utilized to reconstruct the pharynx and esophagus.

Fig. 3.—Reconstruction of pharyngeal defect following surgical removal of cancer. Median pharyngotomy can be successfully employed to remove small lesions. Primary closure should be attempted, but, if it is impossible, small defects epithelialize well.



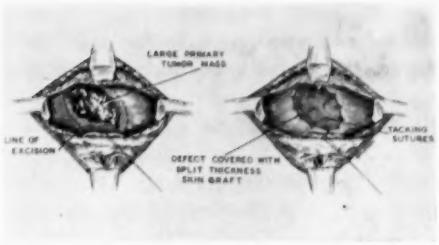


Fig. 4.—Reconstruction of pharyngeal defect following surgical removal of cancer. For larger tumors skin grafts will take well on the firm prevertebral muscles without a stent.

This is accomplished, for example, by preserving the mucosa from both sides of the epiglottis from actually inside of the larynx and from the deep recess of the piriform sinus, if such mucosa is not involved with a tumor. As these facts have been learned, the employment of artificial substitutes has been much less frequent and for the past two years has not been done once. These improvements in technique, together with the discouraging long-term follow-up on the patients with artificial closures that showed such a high recurrence of cancer, make it doubtful that such prosthetic techniques will further improve the salvage rate in these patients. Properly employed surgery will cure certain types of cancer. There is a limit, however, beyond which, despite surgery's newer advances which permit more extensive resections, no cures will be achieved. The exact delineations of these hard-to-define lines have not been fully agreed upon in every part of the body and for all types of tumors. We believe, however, that we have established such a line to our satisfaction in laryngopharyngeal cancer.

Conclusion

When the growth is limited enough to be extirpated by combined neck dissection, total laryngectomy, and partial pharyngectomy

and a primary closure obtained, the end-results indicate that the effort is worth while. Extension of the surgical removal beyond the above limits by means of artificial substitutes can be achieved and is practical from the point of view of operative mortality and morbidity. However, the long-term follow-up indicates that, when the growth is so extensive that these auxiliary measures must be called on, little or no increase in the salvage rate can be expected.

1735 Gilpin St., Denver (7) (Dr. Morfit).

DISCUSSION

DR. HARVEY WILLIS BAKER, Portland, Ore.: Dr. Morfit and his co-authors are to be commended for emphasizing the role of surgery in the treatment of cancer of the laryngopharynx and cervical esophagus. Far too many of these patients are still being treated with irradiation, with generally discouraging results.

Last year before this Association Drs. Grimes and Stephens, of San Francisco, presented a group of patients with cancer of the laryngopharynx and cervical esophagus with a substantial number of long-term survivals. Their patients were all treated by secondary closure, utilizing the Wookey type of two-stage reconstruction. How can we reconcile their results with Dr. Morfit's conclusion that, when primary closure is impossible, surgery is unlikely to cure these lesions?

I think the answer lies in the fact that primary closure is possible far more frequently than one would expect if an attempt is made to preserve a small portion of mucosa of the pharyngeal wall at a distance from the tumor.

[Slide] Here is a typical carcinoma of the laryngopharynx arising in the piriform sinus, as exposed in the operating room. Now, if one makes an attempt to preserve a small portion of normal mucosa instead of resecting the circumference of the pharynx, primary closure will be possible.

[Slide] Here is the operative specimen, showing the larynx, the pharyngeal wall with the tumor, and the metastatic disease in the neck.

[Slide] And here is the operative defect left after such an excision. On the left, the base of the tongue; on the right, the cervical esophagus, and intervening is a small strip of mucosa of the posterior pharyngeal wall which has been left. If one brings the base of the tongue downward, a Y-type suture is possible with primary closure, the pharyngeal mucosa being folded about the feeding tube.

[Slide] Here is closure being accomplished, with the base of the tongue brought downward. If one needs to relieve tension still further, the neck can be flexed, and the upper esophagus can be somewhat mobilized.

[Slide] Here closure is completed and continuity of the upper gastrointestinal tract is restored.

During the past three years at the Veterans Administration Hospital in Portland, we have operated upon 10 patients with carcinoma of the laryngopharynx and have been able to perform a primary closure in each instance. There was one operative death. Two of the patients have since developed recurrent cancer. We believe it is important, however, that no local recurrence has appeared in the mucosa of the pharyngeal wall, indicating to us that it is safe to preserve mucosa at a distance from the tumor in performing a primary closure.

In attempting to define the limits of surgery for these tumors, Dr. Morfit has dealt with a subject of considerable importance. We feel that invasion of the prevertebral fascia or carotid artery or extensive involvement of the skin also makes surgery unlikely to succeed. I should like to ask Dr. Morfit whether he is able to determine the cases unlikely to be successful before surgery or whether operability is determined only after he explores the neck and possibly commits himself to proceed.

DR. JAMES M. WINFIELD, New York: Dr. Morfit's paper was most interesting, and he certainly showed some very excellent results.

I should like to make a plea that more experimental work be carried out in attempting to produce an artificial esophagus on more physiologic bases rather than utilizing foreign bodies. You may remember that in *Surgery* for April, 1955, Dr. Heimlich and I reported a one-stage method for esophageal replacement, creating a gastric tube and anastomosing the antral end to portions of the esophagus and laryngopharynx in dogs, bringing this tube up through the thorax, and we were successful.

Shortly after that—about six months— a letter came from Rumania from a Dr. Gavrilu. This gentleman stated that he had performed 50 such operations upon human beings without mortality. We hardly believed that, but Dr. Heimlich went to Rumania and has just recently returned. He not only saw cases Dr. Gavrilu had operated upon, cases suffering from both benign and malignant lesions of the esophagus, but assisted in two such procedures. The oldest malignant case Dr. Heimlich saw was about four and a half years; the procedure consisted of an extensive resection and removal of a tumor in the cervical esophagus.

Many of the patients of the Rumanian surgeon have survived for a number of years. I believe this is interesting to report, especially as we could not find any publications in our search of the literature. Dr. Gavrilu sent us two articles that

appeared in Rumanian journals, since none of our libraries have had Rumanian journals since 1940. Dr. Ochsner, one of the editors of *Surgery* who received Dr. Gavrilu's letter originally, will probably wish to publish an additional report, as we had made a definite statement that to our knowledge no humans had been operated upon utilizing this particular method of creating a new esophagus.

DR. H. MASON MORFIT, Denver: In answer to Dr. Baker's question as to whether we can always predict operability or inoperability ahead of time, the answer is no. There are occasions when we finish the whole operation and feel we have not accomplished very much. Still, there are certain instances where the extension of the growth is apparent by simple mirror examination, and we think we can rule out at least some of the operations ahead of time.

The development of matted growths into the lateral portions of the neck from metastases, with firm fixation, can also be determined preoperatively, and these cases can be discarded as candidates for operation.

Our main improvements and gains in knowledge in these operations have been simple, little tricks designed to save more of the normal mucosa, which can be accomplished by peeling it off both the front and the back side of the epiglottis. These extra square centimeters of mucosa will permit one to make the primary closure when this would otherwise be impossible.

I certainly agree with Dr. Winfield that the use of foreign bodies to close the defects leaves much to be desired. I do not like the scheme of using the stomach, because with this operation, by the time one gets the tumor out, one has been in the operating room at least three and a half hours, and I do not care to have to open the chest and go through another long procedure. As far as I am concerned, the primary closure can be achieved in more and more cases now with this scheme of preserving the mucosa, and this is a workable procedure and is producing good results. When one has to go on to other procedures when the tumor is so extensive, I do not believe there is an improvement in salvage or palliation.

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The Steroid-Induced Peptic Ulcer

BROCK E. BRUSH, M.D.; MELVIN A. BLOCK, M.D.; THOMAS GEOGHEGAN, M.D.; DWIGHT C. ENSIGN, M.D., and JOHN W. SIGLER, M.D., Detroit

Introduction

The advent of corticotropin (ACTH) and the development of ulcer symptoms in patients on steroid therapy have led to a reevaluation of the peptic ulcer problem. Peptic ulcer previously occurred largely in a certain type of person who was said to have an "ulcer diathesis," but the introduction of new ulcerogenic agents has somewhat changed the picture. It is to be noted that most of these ulcerogenic agents are antiarthritic or antirheumatic compounds, and our material is obtained from patients suffering originally from these chronic ailments. The frequency of peptic ulceration in patients on steroid therapy appears to be more than coincidental. Although a medical ulcer program and discontinuance of the offending agents usually suffice, there are times when complications of the ulcer arise which demand surgical intervention. Our experience with this type of ulcer and its complications forms the basis of this report.

Physiological Considerations

Peptic ulcer has long been designated as a stress disease, and the importance of chronic emotional strain in its pathogenesis has been referred to frequently. Other factors which are to be considered in the pathogenesis of ulcer are tissue resistance, vascular changes, hyperacidity, gastric motility, and general physical condition. The vagus nerve has been considered to be the primary pathway by which this chronic stress is transmitted to the stomach. The work of Dragstedt [1] has established the importance of the vagus nerve in gastric secretion. It is also a fact that stress may be mediated to the stomach by a pure hormonal pathway initiated in the cerebral cortex and transmitted to the stomach by way of the hypothalamus and the pituitary and adrenal glands.[2-5]

The adrenal steroid hormones cause a considerable increase in the secretion of gastric acid and pepsin and may cause the reactivation, perforation, or hemorrhage of a preexisting peptic ulcer or produce a new ulcer. The acid-and-pepsin response to hormone stimulation was shown by Gray and associates [6] to be unaffected by vagotomy or by atropine and methantheline (Banthine) administration. The removal of the gastric antrum also did not affect the gastric response to steroids.

The precise mode of ulcerogenesis by steroids is uncertain. It is of interest that a higher proportion of gastric to duodenal ulcers is found under this type of stress. The following mechanisms of ulcer production or reactivation have been postulated: (1) excessive acid-peptic gastric secretion; (2) a breakdown of the so-called "mucous barrier"; (3) vascular influences resulting in focal ischemia, and (4) destructive action on the connective-tissue "ground substance" with resulting susceptibility to acid-peptic digestion. Since none of these mechanisms have been proved, we must continue to search for a more complete understanding of the ulcer problem.

Hirschowitz, Streeten, Pollard, and Boldt [7] have demonstrated a marked reduction of the viscosity and visible mucous content of the gastric juice preceding an ulcer exacerbation. They suggest that changes

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in the properties and the rate of production of mucus may play an important role in ulcer formation and healing.

Clinical Material

Reports of several cases will elicit some of the problems which may be encountered in the management of arthritic patients who have been on cortisone therapy. It is not always possible or practicable just to stop the steroids, intensively treat the ulcer, and thus remove the problem, since many of these patients require steroids to control their arthritis.

GROUP I.—*Patients Showing Prompt Healing on Medical Therapy: Steroids Discontinued*

This included the great majority of patients, and when the steroid can be discontinued or substituted for the result is satisfactory.

A 48-year-old man seen in August, 1954, because of pain and swelling of the peripheral joints typical of rheumatoid arthritis. History revealed no prior gastrointestinal symptoms. Salicylates, cortisone, corticotropin, and some phenylbutazone (Butazolidin) had been administered and resulted in two months in ulcer distress which brought the patient to our clinic. X-ray of the stomach disclosed a gastric ulcer on the lesser curvature. On hospitalization, with discontinuance of steroids and institution of an intensive ulcer program, the lesion healed promptly and has remained healed.

Figure 1

Figure 2

GROUP II.—*Patients Showing Healing on Medical Therapy: Steroids Continued*

A 58-year-old white man seen in December, 1955, for arthritis. Twenty years previously he had a duodenal ulcer on x-ray and obtained good response to medical therapy. During 1954 he had received cortisone and in 1955 was placed on prednisone (Meticorten), gold therapy, and phenylbutazone. Owing to gastric symptoms, an x-ray was taken and revealed a gastric ulcer. The patient was hospitalized and placed on intensive ulcer therapy, and because of severe arthritis prednisone was continued. The ulcer began to heal promptly. Healing was complete by February, 1956, and subsequent studies have shown no recurrence.

GROUP III.—*Patients with Enlarging Gastric Ulcer Despite Medical Therapy*

A 64-year-old man seen in September, 1954, with severe rheumatoid arthritis. He had a history of duodenal ulcer with spring and fall exacerbations for 25 years. Hydrocortisone had been started, with ulcer symptoms developing within a month. A large lesser curvature gastric ulcer was seen on x-ray (Fig. 1) and gastroscopically appeared benign. Steroids were stopped and ulcer regimen begun, with return of severe joint distress. The gastric ulcer at first decreased in size but two months later (Fig. 2) had enlarged again, and

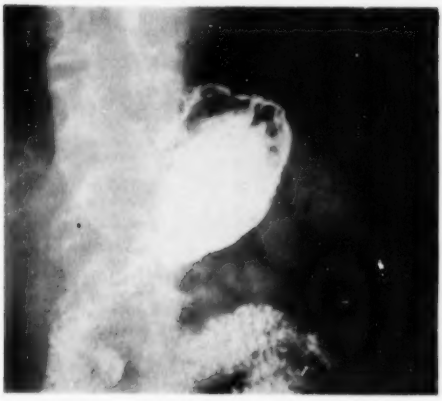

Figure 3

the hemoglobin had dropped to 9 gm. A three-quarter gastrectomy and vagotomy with gastroduodenal anastomosis[8] was done in December, 1954. The ulcer was benign. The patient was again placed on steroids for his arthritis. His preoperative acidity was 64 units, while postoperatively no free acid was present, with only a total of 24 units on histamine stimulation. Subsequent periodic x-rays reveal a normal postoperative (Fig. 3) stomach, and the steroids relieve his joint distress to the degree that he is again usefully employed.

A 52-year-old woman seen in December, 1954, with rheumatoid arthritis of 20 years' duration progressing to complete incapacity and severe pain. She had been treated with gold and salicylates. Stomach x-ray in April, 1955, was normal; acid was high. Prednisone and antacids were begun. Ulcer symptoms developed, and x-ray in September, 1955, revealed prepyloric ulcer (Fig. 4). Steroids were discontinued and ulcer treatment intensified, but symptoms were unchanged. In March, 1956, ulcer symptoms increased, and the ulcer had increased in size despite prolonged therapy. Hospitalization and intensive ulcer therapy failed to reduce the ulcer crater, and a three-quarter resection and vagotomy was performed in April, 1956. The resected ulcer was benign. The patient has been improved and is on steroids. Current x-ray of stomach reveals a normal postoperative state.

GROUP IV.—*Patients with a Gastric Ulcer Suggestive of Malignancy*

A 45-year-old woman, first seen in February, 1956, had been on steroids and salicylates for three years because of arthritis. Two years previously stomach x-ray was normal. Symptoms suggested an ulcer, and an x-ray revealed a prepyloric lesion. Gastroscopically the lesion was suspicious of malignancy. Gastric analysis revealed 0-6 units of free HCl. Surgery was advised, and the resected ulcer was benign. Postoperatively the patient is doing well. She requires a large dose of steroids for her arthritis.

Our experience to date consists of 10 patients who have required surgery for an ulcer which developed while they were on steroids and 1 who developed acute hemorrhage while on rauwolfia. Surgery has become necessary in about 10% of the patients developing a steroid ulcer, while the remainder have been treated satisfactorily by medical means.

Comment

Peptic ulcers occurring in the patient receiving steroids usually are gastric rather than duodenal. The patients in our series had a high incidence of prior duodenal ulcers. The gastric ulcers are acute, and symptoms may occur shortly after the onset of steroid therapy. Some observers have noted a relatively high incidence of hemorrhage,[9] and perforations have also been recorded.

While iatrogenic ulcers have a somewhat less tendency to become malignant, this complication must be kept in mind. The

Figure 4

TABLE 1.—*Gastric Ulcer: Diagnostic Procedures*

1. Roentgen examination with careful fluoroscopy
2. Gastric analysis
3. Gastroscopy
4. Cytologic studies of gastric aspiration material
5. Trial of medical therapy during bed rest in hospital
6. Progress x-rays at suitable intervals
7. Progress gastroscopic observation
8. Careful reevaluation of progress by diagnostic procedures

possibility that a gastric ulceration is malignant from the onset is ever present. The diagnostic methods for evaluation and reevaluation of a gastric ulcer, together with its management, have been outlined by one of us (B. E. B.)[10] (Table 1).

The answer to the problem of iatrogenic ulcer lies not in abandoning these potent agents but in using them with discretion and caution. A majority of these ulcers will respond promptly to withdrawal of the offending agent and institution of a good ulcer regimen.[11,12] With a rigid ulcer program it is often possible to continue the use of corticosteroids without impairment of ulcer healing.

Surgical intervention is necessary for perforation, for severe hemorrhage, and, when medical management fails, to heal a gastric ulcer. In certain severe cases of rheumatoid arthritis steroids may be necessary. When these patients develop a gastric ulcer, a three-quarter gastrectomy plus vagotomy gives the combined benefits of eliminating the ulcer and permitting the patient to resume steroids. Our indications for surgery are given in Table 2.

When surgery is to be performed on a patient who has recently been on steroid therapy, it is essential to give steroids during the operative period. The dangers of an anesthetic and operative trauma to a patient in adrenal deficiency have been stressed by one of us (B. E. B.).[13]

TABLE 2.—*Indications for Surgery*

1. Question of malignancy in a gastric ulcer
   A. Initial x-ray, gastroscopic, and clinical impression
   B. Lack of improvement on intensive therapy
   C. Recurrent ulceration
2. Complications of ulcer which ordinarily require surgery
   A. Hemorrhage
   B. Perforation
   C. Obstruction
3. An ulcer which continues seriously symptomatic while on intensive ulcer therapy in the patient who requires steroid therapy for other disease.

Summary

A history of previous ulcer symptoms was obtained in more than 50% of the patients who developed acute ulcer symptoms while on steroid therapy.

A high proportion of gastric ulcers was noted.

A gastric ulcer occurring in a patient who is taking steroid medication must be treated with the same suspicion of malignancy as that of the patient not on steroids.

A trial of medical therapy in the hospital is recommended for those patients developing a gastric ulcer in whom the initial evaluation is reassuring.

When progress studies fail to demonstrate complete healing in from four to six weeks, prompt surgical intervention is recommended.

In our experience, when surgery is indicated, a three-quarter gastrectomy plus vagotomy has enabled the patient to resume steroid therapy when necessary.

The adrenal status of every patient who has been on steroids recently must be tested prior to surgery. If adrenal insufficiency is present, steroids must be given preoperatively and for several days postoperatively.

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The Billroth I and Billroth II Operations

Comparison of Results Six to Ten Years After Operation for Gastric, Duodenal, and Gastrojejunal Ulcers

WALTMAN WALTERS, M.D., and THOMAS E. LYNN, M.D., Rochester, Minn.

For this study we traced 729 patients (610 men and 119 women) who had undergone gastric resection of the Billroth II type for peptic ulcer 6 to 10 years previously at the Mayo Clinic. In our previously reported long-term follow-up study of the Billroth I operation for peptic ulcer, 185 patients (139 men and 46 women) were followed for 6 to 10 years. We shall contrast the results in the Billroth I series with the results in the Billroth II series reported in this paper. The average amount of stomach resected approximated two-thirds in both series.

Material and Follow-Up

Review of records of alternate patients who underwent a Billroth II operation for peptic ulcer in the years 1945 through 1949 provided 896 cases for this study. Follow-up data were collected by means of questionnaires sent or recent evaluation at the clinic. Follow-up data were available on 729 patients. Of the 167 patients on whom follow-up data were not available, 98 did not reply or could not be located, and 69 died within six years of their operation. Included in this last group are the 15 operative deaths, an operative mortality of 1.7%. The operative mortality in the Billroth I series was 1.2%.

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From the Section of Surgery, Mayo Clinic and Mayo Foundation. The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota. Fellow in Surgery, Mayo Foundation (Dr. Lynn).

Recurrences

Of the 729 patients in the Billroth II series, 3.7% (23 men and 4 women) were proved to have recurrent ulcers and 1.6% (11 men and 1 woman) were suspected of having recurrent ulcers. Recurrences were considered as proved when a recurrent ulcer was found at reoperation or the crater was demonstrated on roentgenologic examination of the stomach and duodenum. The condition was classed as a suspected recurrence when the patient had symptoms of recur-

TABLE 1.—*Recurrences Six to Ten Years After Billroth Operations for Peptic Ulcer*

Site of Ulcer and Operation	Traced Cases	Recurrences			
		Proved		Suspected	
		No.	Per Cent	No.	Per Cent
Peptic ulcer, total					
Billroth II	729	27	3.7	12	1.6
Billroth I	185	12	6.5	5	2.7
Duodenal ulcer					
Billroth II	449	16	3.6	9	2.0
Billroth I	27	2	7.4	2	7.4
Gastric ulcer					
Billroth II	139	4	2.9	0	--
Billroth I	113	5	4.4	1	0.9
Pyloric or combined gastric and duodenal ulcers					
Billroth II	54	0	--	0	--
Billroth I	19	0	--	0	--
Gastrojejunal ulcer					
After gastroenterostomy					
Billroth II	76	4	5.3	3	3.9
Billroth I	24	5	20.8	1	4.2
After gastric resection					
Billroth II	11	3	27.3	0	--
Billroth I	2	0	--	1	--
Total					
Billroth II	87	7	8.0	3	3.4
Billroth I	26	5	19.2	2	7.7

TABLE 2.—*Recurrences Six to Ten Years After Billroth Operations for Peptic Ulcer According to Sex of Patients*

	Billroth II				Billroth I			
	Men		Women		Men		Women	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Peptic ulcer, all patients	610		119		139		46	
Recurrences, proved	23	3.8	4	3.4	9	6.5	3	6.5
Suspected	11	1.8	1	0.8	2	1.4	3	6.5
Duodenal ulcer	386		63		20		7	
Recurrences, proved	13	3.3	3	4.8	1	5.0	1	14.2
Suspected	8	20.7	1	1.6	1	5.0	1	14.2
Gastric ulcer	108		31		84		29	
Recurrences, proved	4	3.7	0	--	4	4.8	1	3.4
Suspected	0	--	0	--	0	--	1	3.4
Pyloric or combined gastric and duodenal ulcers	44		10		13		6	
Recurrences, proved	0	--	0	--	0	--	0	--
Gastrojejunal ulcer	72		15		22		4	
Recurrences, proved	6	8.3	1	6.7	4	18.1	1	25.0
Suspected	3	4.2	0	--	1	4.5	1	25.0

ring ulcer or had had gastrointestinal bleeding or both.

More specifically, the proved recurrence rate among patients with duodenal ulcer was was 3.6%; among those with gastric ulcer, 2.9% and among those with gastrojejunal ulcer, 8.0%. There were no proved recurrences in 54 patients with pyloric ulcer or combined gastric and duodenal ulcers (Tables 1 and 2).

Of the 185 patients in the Billroth I series, 6.5% (9 men and 3 women) had proved recurrent ulcers.

Duodenal Ulcer.—Among the 449 traced patients (386 men and 63 women) with duodenal ulcer who had Billroth II resections, there were 16 (3.6%; 13 men [3.4%] and 3 women [4.8%]) with proved recurrences. In all but three cases the recurrence was at the site of anastomosis or in the jejunum. Nine additional patients (eight men and one woman) were suspected of having a recurrence. Of the 27 patients (20 men and 7 women) who had had the Billroth I operation for duodenal ulcer, 2 (1 man and 1 woman; 7.4%) were proved to have recurrent ulcers, and 2 (1 man and 1 woman; 7.4%) were suspected of having recurrences. The infrequent use of the Billroth I operation for duodenal ulcer does not allow an authoritative comparison with the much larger Billroth II group.

Gastric Ulcer.—A comparable number of Billroth II and Billroth I operations were performed for gastric ulcer. Of the 139 patients (108 men and 31 women) who had the Billroth II operation for gastric ulcer, 4 (2.9%) had proved recurrences; all four ulcers were in men. There were no suspected recurrences. All but one of the recurrences were anastomotic or jejunal. Of 113 patients (84 men and 29 women) who had Billroth I operations for gastric ulcer, 5 (4.4%; 4 men and 1 woman) were proved to have recurrent ulcers and 1 (a woman; 0.9%) was suspected of having one.

Gastrojejunal Ulcer.—Eighty-seven patients (seventy-two men and fifteen women) had undergone removal of a gastrojejunal ulcer, gastric resection, and a Billroth II anastomosis. In 76 patients the ulcer had followed gastroenterostomy, in 8 it had followed a Billroth II operation, and in 3 it had followed a Billroth I type of gastric resection. Seven patients (six men and one woman; 8.0%) had proved recurrences. In all but one the recurrence was anastomotic or jejunal. Four of the recurrent ulcers were in the group in which a gastroenterostomy had been performed originally, and three were in patients in whom a gastric resection had been the original procedure. Of the latter, two had had Billroth I operations previously; one had had a Billroth II resection. Three patients (all men) were suspected of having recurrences in the whole group of eighty-seven with gastrojejunal ulcer. The primary operation on all three had been gastroenterostomy. Among 26 (22 men and 4 women) who had Billroth I

anastomoses after resection for gastrojejunal ulcer, 5 (4 men and 1 woman; 19.2%) were proved to have recurrent ulcers and 2 (1 man and 1 woman; 7.7%) were suspected of having them.

Pyloric Ulcers and Combined Gastric and Duodenal Ulcers.—None of the 54 patients (44 men and 10 women) who had Billroth II gastric operations for these types of peptic ulcer were proved to have, or suspected of having, recurrences. Neither were there any proved or suspected recurrences among the 19 patients with these types of ulcers in the Billroth I series.

Amount of Stomach Removed

When the results of a gastric resection are being evaluated, it is important to have a record of the amount of stomach that has been excised. Capper and Welbourn reported that their survey of the long-term results of gastric surgery for peptic ulcer indicated that recurrence was proved in 8.2% and suspected in 4.5% of patients following the Billroth I anastomosis, as compared with proved recurrence in 1.8% and suspected recurrence in 0.8% of patients after the Billroth II anastomosis, when less than 70% of the stomach was resected. When more than 70% was resected, the recurrence rate was 0.9% proved and 0.4% suspected after the Billroth I anastomosis and 1.3% proved and 0.8% suspected after the Billroth II anastomosis.

In the 39 cases of our group of 729 in the Billroth II group in which recurrences were proved or suspected, the surgeons' estimates of the amount of stomach removed were studied. The surgeons' estimates of the amount of stomach removed averaged about 66% (Table 3). In all but two cases the surgeon had estimated that 60% or more of the stomach was removed.

TABLE 3.—*Amount of Stomach Removed in Cases in Which Recurrences Developed Six to Ten Years After Billroth II Operations*

Amount of Stomach Removed		Cases
Surgeon's estimate	⅓	2
	½	31
	¾	6
Pathologist measured	7–9 cm.	2
	10–12 cm.	22
	13–15 cm.	10
	17–18 cm.	1
	20 cm.	1
Previous resection		3

Gastric Acidity

Postoperative studies of gastric acidity were carried out in approximately a third of the cases in both the Billroth I and the Billroth II series. Analysis of the cases in which these studies were done revealed that achlorhydria was obtained by 44% of the patients in the Billroth I series and by 81% of those in the Billroth II series. This is in accord with a planned study carried out previously by one of us (W. W.), which showed that 42% of the patients having a Billroth I type of anastomosis after gastric resection for duodenal ulcer obtained achlorhydria. In contrast, 72% of the patients obtained achlorhydria after the Billroth II type of anastomosis when approximately the same amount of stomach was resected.

Recurrences of Ulcer Reported in the Literature

Wallensten in 1954 reported on 202 Billroth I operations (43 for gastric ulcer and 159 for duodenal ulcer) and 322 Billroth II operations (76 for gastric ulcer and 255 for duodenal ulcer) with a 4- to 20-year follow-up. The average estimated amount of stomach resected was two-thirds. Wallensten found 17 recurrences in the Billroth I series (8.4%). Fourteen were proved at operation (thirteen in the duodenal ulcer group and one in the gastric ulcer group), and three were indicated by recurrent bleeding from the upper part of the gastrointestinal tract (one in the duodenal ulcer group, one in the gastric ulcer group, and one in the group of combined gastric and duodenal ulcers). In the Billroth II series he found eight recurrences (2.5%); two (both in duodenal ulcer series) were proved at operation, and six (all in duodenal ulcer group) were suspected. He concluded that

the indications for choosing the operation were as follows: For men with duodenal ulcer, the Billroth II operation is indicated; for men with gastric ulcer, the Billroth I operation, and for women with either duodenal or gastric ulcer, the Billroth I operation.

The report of Capper and Welbourn summarizing more than 1000 cases of duodenal ulcer from the British surgical clinics has been referred to.

Goligher and co-workers recently gave results of the Billroth I operation for duodenal ulcer on 80 patients who were followed for three or more years. They found 11 proved recurrences (13.7%) and 3 suspected ones (3.7%). They contrasted these results with those of the Billroth II operation in 106 cases, in which there were 1 proved and 1 suspected recurrence, an incidence of less than 1% for each.

Ordahl, Ross, and Baker reported in July, 1955, on 35 traced cases in which a Billroth I operation was done for duodenal ulcer. They found 10 recurrences, an incidence of 28.6%. In 64 traced cases in which a Billroth II procedure was done, there were four recurrences, an incidence of 6%. In their gastric ulcer series there was one recurrence in 22 cases (4.5%) after the Billroth I operation and none in 13 cases after the Billroth II operation.

Harkins and his colleagues[3] in a recent report analyzed 451 cases of benign gastroduodenal lesions for which gastric resection and Billroth I anastomoses had been carried out. The follow-up period was from one to eight years. The incidence of proved recurrence was given as 1.1%, with an additional 2.5% having postoperative bleeding. In 93 cases of gastric ulcer there was one proved recurrence (1.1%), and in 274 cases of duodenal ulcer there were only two proved recurrences (0.7%). In this series effort was made to remove approximately three-quarters of the stomach in all cases. Although the follow-up period in many of these cases was too short to allow conclusions, the results, like those of Capper and Welbourn, suggest that high resection is advantageous when the Billroth I procedure is being used.

Weir and Bennett traced 441 of 569 consecutive cases of duodenal, gastric, and jejunal ulcer in which a partial gastrectomy had been performed three to four years previously. Among the 254 patients having the Billroth II operation for duodenal ulcer, 7 (2.8%) had proved recurrences; 2 (40%) of 5 patients having the Billroth I operation for duodenal ulcer had proved recurrences. Twenty-four patients had Billroth I procedures and ninety-one Billroth II operations for gastric ulcer with no proved recurrences in either group.* One recurrence was suspected in the Billroth II series. Of 61 patients having Billroth II operations for jejunal ulcer, 5 were proved to have recurrences (8.2%). Six patients underwent Billroth I procedures for jejunal ulcer without any recurrence.

Ransom, in 1947, reported results of subtotal gastrectomy for gastric ulcer. Among 138 patients with benign gastric ulcer treated by the Billroth II type of resection and followed for at least two years, 4 had proved recurrences, an incidence of 3%.

Functional Results

This presentation would not be complete without mention of the functional results (Table 4). In the 729 patients who had Billroth II operations, 92% were found to have excellent or good results. In the Billroth I series, 88% of the patients reported excellent or good results. When the evidence of recurrences was disregarded in our consideration of the functional result, we found that 2% of the patients in both series continued to have severe postgastrectomy symptoms after six years.

In the main, the postgastrectomy symptoms consisted of the dumping syndrome, decreased gastric capacity, inability to maintain satisfactory weight, or bilious vomiting. Although bilious vomiting was slightly commoner in the Billroth II series, our follow-up

* We found two recurrences in 1945 and one in 1948 after Billroth II operations.

TABLE 4.—*Functional Results Six to Ten Years After Billroth Operations for Peptic Ulcer*

	Gastric Ulcer		Duodenal Ulcer		Gastrojejunal Ulcer	
	Billroth		Billroth		Billroth	
	II	I	II	I	II	I
Total Cases	139	113	449	27	87	26
Results, per cent						
Excellent *	64.0	59.3	57.0	37.0	54.0	38.5
Good †	31.7	33.6	35.4	40.8	28.9	30.8
Fair ‡	1.4	2.7	2.5	11.1	6.9	7.7
Unsatisfactory §	2.9	4.4	5.1	11.1	10.4	23.0

* Excellent: No further distress.
† Good: Minor symptoms, usually mild dumping syndrome.
‡ Fair: Fairly severe symptoms but better than before operation.
§ Unsatisfactory: Not improved or worse; recurrent ulcer.

analysis was not critical enough on that point to establish a significant difference. In essence we were unable to discern a significant difference in the functional results when the Billroth I and Billroth II series were compared.

Summary

We have presented the results obtained by 729 patients who underwent the Billroth II operation for peptic ulcer. The duration of the follow-up was 6 to 10 years. The operative mortality was 1.7%. Recurrences were proved in 3.7% of the patients and suspected in an additional 1.6%. Proved recurrences occurred in 3.6% of those with duodenal ulcer, in 2.9% of those with gastric ulcer, and in 8.0% of those with gastrojejunal ulcer. The sex incidence of recurrence was essentially equal except among patients with gastric ulcer. In this group all four proved recurrences were in men. Ninety-two per cent of the patients had excellent or good functional results. When ulcer recurrences are disregarded, an additional 2% of the patients continue to have severe postgastrectomy symptoms.

Comparison has been made with 185 cases in which the Billroth I procedure was employed for peptic ulcer with a corresponding 6- to 10-year follow-up. The average amount of stomach resected approximated two-thirds in both groups. The over-all percentage incidence of proved and suspected recurrences in the Billroth I series was twice that in the Billroth II series. For gastric ulcer the percentage incidences of proved recurrences were essentially equal in the two series. For duodenal ulcer the percentage incidence of proved recurrence in the Billroth I series was twice that in the Billroth II series. The limited use of the Billroth I operation for duodenal ulcer, however, prevents authoritative comparison.

For gastrojejunal ulcer the rate of recurrence after the Billroth I series was nearly two-and-one-half times that after the Billroth II series. Again the Billroth I operation was employed too infrequently to allow critical comparison.

There were no proved or suspected recurrences in either series in the treatment of combined gastric and duodenal or pyloric ulcers.

Comparison of the Billroth I and Billroth II operations as to functional results failed to reveal any significant difference.

Mayo Clinic.

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Peripheral Blood Flow and Blood Volume Studies in the Dumping Syndrome

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The dumping syndrome is a symptom complex which is frequently seen following gastric resection. It is characterized by a sensation of fullness or churning in the epigastrium, associated with, or followed by, sweating, tachycardia, weakness, syncope, often a sensation of warmth, occasionally explosive diarrhea, and consistently improved by lying down. It may be seen following any gastric operation in which the pyloric sphincter mechanism is destroyed, and it is usually seen in its severest form following total gastrectomy. However, it is sufficiently frequent after subtotal resections to constitute a serious problem.

The dumping syndrome must be clearly differentiated from other types of dysfunction that may follow gastric resection. One of these is spontaneous hypoglycemia, which is physiological in nature and is characterized by the fact that it occurs 1½ to 2 hours after meals and is relieved by the ingestion of sugar, whereas dumping symptoms consistently have their onset within 10 to 30 minutes after meals and a state of hyperglycemia actually exists.[1] The present study concerns itself only with the immediate postprandial dumping syndrome and not with the late hypoglycemic type of postgastrectomy disturbance.

Many theories have been advanced to explain the dumping symptoms. While some have felt that it was largely a psychosomatic problem, more recent physiological observations have not substantiated this concept. Dumping attacks were first described by Hertz,[6] who noted the very rapid gastric emptying which is characteristic. The gastric emptying rate of "dumpers" is generally felt to be more rapid than the already accelerated emptying seen after gastric resections. It was shown by Machella [8,9] that the oral ingestion of hypertonic solutions would accurately reproduce the dumping syndrome in many patients after gastric resections. He also observed that the direct intrajejunal administration of hypertonic solutions to patients with jejunostomies or in patients intubated with long intestinal tubes would produce similar reactions. It has been postulated that mechanical distention of the jejunum resulted from the dilution of hypertonic solutions or hydrolyzed food particles and that this distention, in turn, stimulated the splanchnic nerves, resulting in a systemic sympathetic response. There have been reports that balloon distention of the jejunum will result in symptoms characteristic of the dumping syndrome; however, this has not been a consistent finding.[3,9] Various attempts have been made to block the presumed splanchnic stimulus by use of pharmacological agents or by splanchnicectomy, but none of these attempts have been consistently successful.[3]

TABLE 1.—*Dumping Syndrome*

Characteristics	Symptoms
Rapid gastric emptying	Nausea & fullness
Onset 10-30 min. p.c.	Sensation of warmth
Hyperglycemia—not related to hypoglycemia	Dizziness
Plasma volume shift	Weakness
	Sweating
	Diarrhea—variable
	Palpitation—tachycardia
	Eased—by lying down

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TABLE 2.—*Patients with Gastric Resection Who Received 150 Cc. of 50% Dextrose as Test Meal*

Case, No.	Control Values		Maximum Change		Symptoms Induced
	Plasma Vol., Cc.	Peripheral Blood Flow, Cu. Mm./Sec.	Plasma Vol., Cc.	Peripheral Blood Flow, Cu. Mm./Sec.	
1	2,450	3.5	1,740	32.	Severe
2	2,380	5.	1,920	7.	Severe
3	2,780	1.5	2,240	16.	Severe
4	2,100	4.	1,660	8.	Severe
5	2,840	2.2	2,374	6.6	Severe
6	2,400	12.	1,760	27.	Severe
7	3,000	5.	2,680	25.	Moderate
8	2,220	4.	1,790	13.	Moderate
9	----	15.	----	22.	Moderate
10	----	12.	----	17.	Moderate
11	----	2.	----	7.	Moderate
12	3,125	7.	2,780	11.	Moderate
13	3,150	5.0	2,530	3.5	Mild *
14	2,700	7.0	1,965	1.0	Mild *
15	2,920	1.5	2,620	1.5	None

* Usually epigastric fullness only.

Smith [11] has shown that definite electrocardiographic changes occur during the height of dumping attacks. These electrocardiographic changes affect primarily the ST segments and T waves and are suggestive of temporary myocardial anoxia. Smith [11] has likewise demonstrated a fall in serum potassium and phosphate. However, the serum potassium fall occurs after the peak of the symptoms has passed, which makes it an unlikely etiologic factor, although this late transient hypokalemia may play some part in the feeling of weakness which sometimes persists up to one hour after the attacks.

More recently, definite reductions in plasma volume have been demonstrated by Roberts and associates, which correlate closely with the peak of the dumping symptoms.[10] It is felt that the plasma volume shifts in these patients act as a stimulating mechanism for the widespread sympathetic response. The fall in plasma volume is explained by the fact that extracellular fluid (and consequently plasma) is shifted into the jejunum in response to the high molecular concentration which has resulted from excessively rapid gastric emptying. The same workers have also shown a decrease in cardiac output during simulated dumping in experimental animals.[7]

The decreases in plasma volume which accompany the dumping attacks usually range from approximately 300 cc. to 750 cc. It would seem that the usual homeostatic mechanisms should be able to compensate for this amount of plasma volume reduction without such severe symptoms. It has been observed that persons may lose 500 cc. of whole blood without systemic effects such as are seen in the dumping syndrome. Many blood donors are examples of this. In addition, we have observed, in studying the plasma volume changes in patients who have had gastric resections, that many had plasma volume decreases without actual dumping symptoms. These observations suggested that there may be other changes which might play a significant part in the production of the dumping symptoms. The frequency with which patients complained of a sensation of warmth and heat during

TABLE 3.—*Persons with Intact Stomachs to Whom Hypertonic Dextrose Was Given Through Intestinal Tube*

Case, No.	Control Values		Maximum Change		Symptoms Induced
	Plasma Vol., Cc.	Peripheral Blood Flow, Cu. Mm./Sec.	Plasma Vol., Cc.	Peripheral Blood Flow, Cu. Mm./Sec.	
1	----	1.5	----	10.	Moderate
2	3,310	9.5	2,890	13.	Mild to Moderate
3	3,306	6.	2,893	1.5	None
4	3,190	2.0	2,720	2.0	None
5	3,220	1.0	3,000	15.	Severe

attacks further suggested that peripheral vasodilatation might be occurring, with a shift of blood away from the vital body centers. Consequently, a study was made to determine whether or not any changes in peripheral blood flow occurred and to correlate such possible changes with plasma volume studies and clinical symptoms.

Methods and Materials

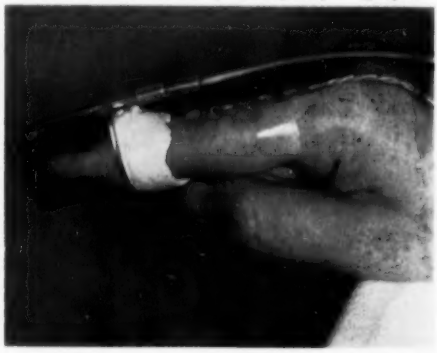
Experiments were performed on 15 patients who had had previous subtotal gastric resections; most of them had clinical manifestations of the dumping syndrome (Table 2). In addition, five persons with normal, intact stomachs were studied by means of intrajejunal administration of dextrose through a long intestinal tube (Table 3). An additional group of six persons with normal, intact stomachs were given oral test meals for control purposes. The studies consisted of serial plasma volume determinations, determinations of blood pressure, pulse, and hematocrits, and vasographic studies. Electrocardiographic and electroencephalographic tracings were made on some patients. The vasographic studies consisted of measurements of peripheral blood flow in cubic millimeters per second, volume pulsations, skin temperatures, and oscillometric observations. After a suitable control period the patients were given a hypertonic solution consisting of 150 cc. of 50% dextrose as a test meal, orally in the gastric resection and control groups and through the intestinal tube in the remaining group. Plasma volume determinations were done with Evans Blue Dye (T 1824), using the indirect technique as described by Gibson and Evans.[6] The vasographic observations were made by use of a Winsor[18] Vasograph, which is a direct volume-recording pneumoplethysmograph which measures actual volume changes in suitable digits. Skin temperatures were measured by thermisters attached to the digits being studied. Figure 1 illustrates the type of plethysmograph attachment used.

Results

Changes in Blood Volume.—The results of blood volume changes are very similar to those found by Roberts and associates.[19] All patients showed a decrease in plasma volume, ranging from 300 to 750 cc. These plasma volume decreases were greatest at the peak of the dumping symptoms. The plasma volume decreases were consistently associated with a slight rise in the hematocrit.

Changes in Peripheral Blood Flow, Skin Temperatures, and Volume Pulsations.—Definite increases in peripheral blood flow, as measured by the plethysmograph, were present in those patients who had moderate to severe clinical symptoms of dumping. Those patients who developed systemic symptoms, such as dizziness, weakness, sweating, and tachycardia, were particularly noted to have this increased peripheral blood flow. These same patients also showed a definite increase in peripheral skin temperature and in the amplitude of their volume pulsations. There were some patients, however, with definite plasma volume reductions who did not have evidence of increased peripheral blood flow or increased skin temperature; in fact, some patients showed evidence of vasoconstriction with decreased blood flow and decreased skin temperature. It is important to note that this group did not exhibit the symptoms of weakness, dizziness, sweating, tachycardia, and sensations of warmth during induced dumping attacks. Their symptoms, if any, consisted essentially of nausea and epigastric fullness or discomfort. This relationship between increased peripheral blood flow, increased skin temperatures, and the systemic symptoms was striking. In the patients with the systemic-type symptoms the increases in peripheral blood flow ranged from 1½ times the control values to 12 times the control values and correlated with the clinical severity of the attacks, while in the patients

Fig. 1.—Photograph illustrating typical digit attachment of the Winsor pneumoplethysmograph.



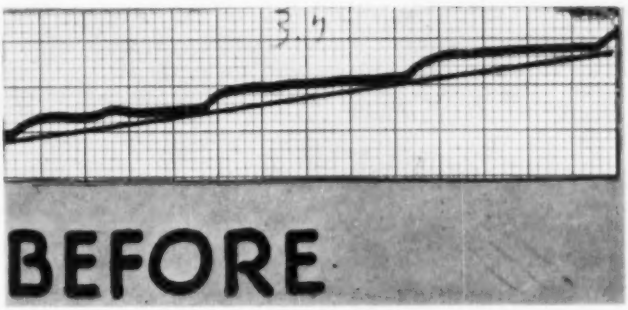


Fig. 2A.—Pneumoplethysmographic tracing taken during control period before test meal.

who had only abdominal manifestations of dumping, such as epigastric fullness and nausea but with plasma volume shifts, the peripheral blood flow changes were either minimal or, in some instances, reduced. The skin temperatures followed a pattern similar to the peripheral blood flow. Increases of 3 to 5 degrees (C) occurred in the group with the increased blood flow, whereas the temperatures generally either remained unchanged or decreased in the patients who did not have peripheral blood flow increases.

Other Observations.—In those patients in whom electrocardiographic observations were made, changes were noted similar to those described by others. These changes consisted mainly of flattening of the T wave and elevation or depression of the S-T segments. In view of the symptoms which occur in the dumping syndrome, such as severe dizziness and sometimes even blurring of vision, temporary mental confusion, and somnolence, it was felt that a study of the electroencephalographic patterns during dumping attacks might be helpful. Two patients with severe dumping attacks had serial electroencephalograms during a control period and during an induced attack of dumping. It was observed that definite dysrhythmias occurred at the height of the dumping symptoms. These dysrhythmias promptly disappeared after the subsidence of symptoms. The electroencephalographer interpreted these changes, although nonspecific in nature, as suggestive of cerebral cortical anoxia. To our knowledge, this observation has not been previously described. Serum potassium determinations which were done earlier in the study showed no correlation with the severe phase of the dumping attack. The results of the changes in plasma volume, peripheral blood flow, and skin temperatures for the group of patients with subtotal gastrectomy are summarized in Table 1. Table 2 is a summary of findings following the intrajejunal administration of hypertonic dextrose through a long intestinal tube to a group of patients with normal, intact stomachs.

Case 1.—A 46-year-old woman had severe postprandial symptoms, consisting of nausea, a feeling of warmth, syncope, and weakness, with onset 15 minutes after each meal. These attacks were incapacitating in their severity, and the patient

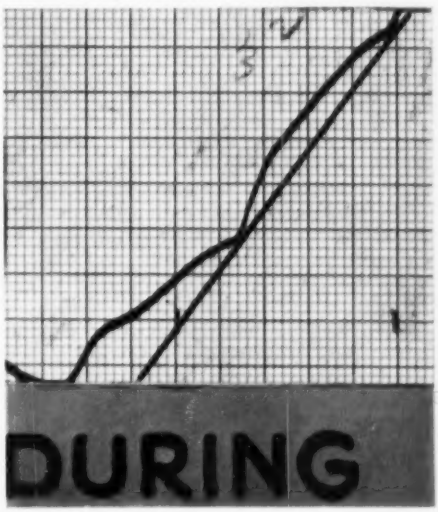


Fig. 2B.—Pneumoplethysmographic tracing taken during height of dumping symptoms after test meal; the sharp rise indicates an elevenfold increase in peripheral blood flow.

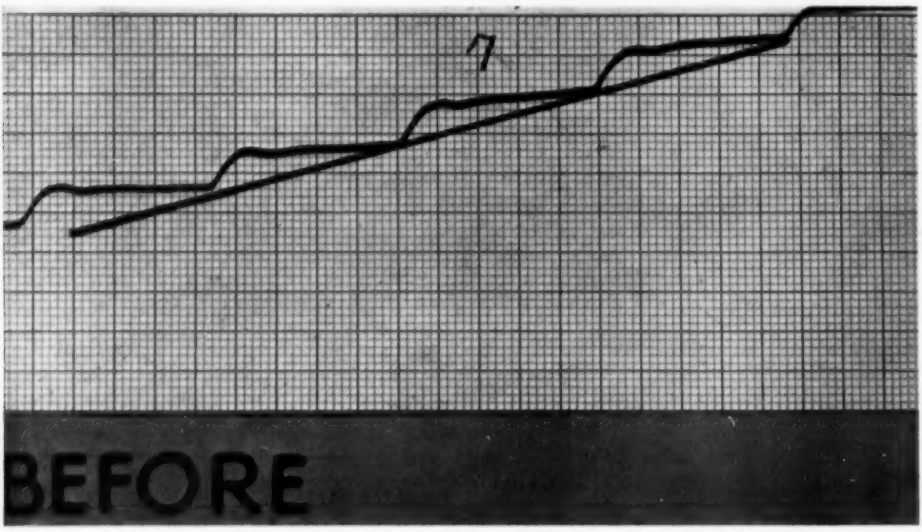


Fig. 3A.—Pneumoplethysmographic tracing taken during control period before test meal.

was forced to lie down for at least one hour to obtain partial relief after eating. These dumping attacks began after a gastric resection (large stoma Billroth II) performed three years earlier for duodenal ulcer disease. The patient was given a test meal of hypertonic dextrose, and a sharp reduction in blood volume was produced, associated with a pronounced increase in peripheral blood flow (Case 1, Table 1). Another operation was performed on the patient after these studies, and her previous operation was changed to a small stoma end-to-side Billroth I. Following this, the clinical symptoms of dumping have disappeared. The blood volume and blood flow studies were repeated two months after surgery, and marked improvement was found.

Case 14.—A 69-year-old man had postprandial distress, consisting of a feeling of epigastric fullness, since having a gastric resection (Billroth II, Polya type) five years ago. This epigastric distress came on immediately after eating and caused the patient to limit his food intake. He had not had syncope, sweating, or weakness associated with these attacks at any time. The patient was given a test meal of hypertonic dextrose, and a severe reduction in plasma volume was produced; however, a decrease in peripheral blood flow was noted. There were no symptoms of syncope, weakness, or sweating produced by the test meal, but the feeling of epigastric fullness was reproduced. This case illustrates the type of postgastrectomy syndrome with abdominal symptoms and plasma volume reduction without severe systemic manifestations (Case 14, Table 1).

Comment

Several investigators have shown that the rapid intrajejunal administration of hypertonic solutions closely reproduces the signs and symptoms of the dumping syndrome and consequently affords an excellent means for experimental study of the physiological changes which occur. It has been well established that definite decreases in plasma volume and also electrocardiographic changes occur simultaneously with the severest symptoms in dumping attacks.[10] It is well known that when hypertonic solutions (hypertonic saline or starch are equally effective) are introduced into the upper jejunum a shift of extracellular water into the jejunal lumen results in order to bring the intestinal contents into isotonicity with the blood plasma. This is an alteration which apparently occurs rapidly. Roberts et al.[10,12] have postulated that the acute reduction in circulating blood volume which follows the shift of fluid into the jejunum results in sympathetic stimulation of the pressoreceptors located in the aortic arch, carotid sinus, and near the mesenteric vessels. The electrocardiographic changes, although they are

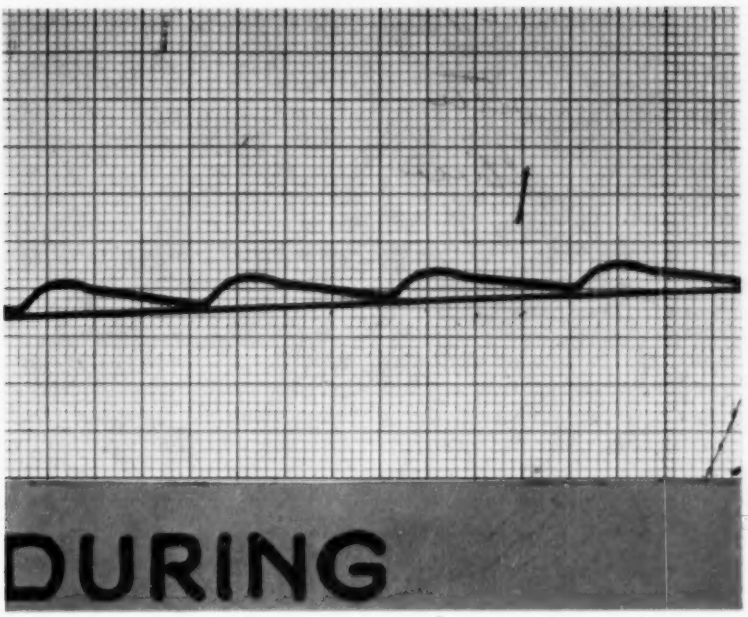


Fig. 3B.—Pneumoplethysmographic tracing taken after test meal; the patient complained of epigastric fullness but no systemic symptoms; the fall on the tracing represents a decrease in peripheral blood flow.

not specific, are similar to changes seen in coronary insufficiency and suggest temporary myocardial anoxia.

The finding of a correlation between increased peripheral blood flow and dumping symptoms could prove to be significant. It is evident that an increase in peripheral blood flow of several times the control values would involve a peripheral intravascular shift or pooling of considerable quantities of blood and could result in reduced blood flow to the central vital areas, such as the brain and the heart. Such intravascular shifts might even be quantitatively greater than the plasma volume reductions which have been demonstrated. The changes in the electroencephalogram and the electrocardiogram during dumping attacks suggest that some such central anoxia as this may occur. Those patients with subtotal gastrectomy with plasma volume shifts, but who show peripheral vasoconstriction and normal or reduced peripheral blood flow, tend to have minimal systemic symptoms. The normal response to a blood volume decrease is to resist any tendencies for cardiac output reduction. Peripheral vasoconstriction and increased heart rate are among the fundamental mechanisms involved in the maintenance of the cardiac output.

It would appear that patients with severe clinical dumping have an abnormal type of response to sudden reductions in plasma volume in that peripheral vasodilatation may occur, instead of the protective vasoconstriction that one would expect. In view of this it would appear that the patients who develop the typical dumping syndrome may be persons who have abnormal homeostatic vascular responses. It is probable that in most instances the body's mechanisms can quickly compensate for the acute loss of perhaps 500 cc. of circulating blood if the usual phenomenon of peripheral vasoconstriction occurs with redirection of the blood mass to the central areas. However, the sudden loss of a similar amount of circulating plasma volume may result in systemic symptoms in a person who responds by vasodilatation and peripheral blood pooling. One might

expect that a fall in blood pressure would accompany the dumping symptoms if peripheral vasodilatation were present; however, the blood pressure tends to remain relatively stable. The maintenance of a normal blood pressure in the presence of peripheral vasodilatation could be explained by (1) opening of arteriovenous shunts (metarterioles) rather than by dilation of the arterioles themselves and (2) compensatory vasoconstriction elsewhere, such as in the splanchnic or other visceral areas.

There are numerous patients who after subtotal gastrectomy do not have classical dumping attacks but who do have a feeling of nausea or fullness which prevents them from eating adequate amounts of food. While many of these patients have plasma volume reductions, their vascular responses are such that apparently large intravascular shifts are prevented. This feeling of epigastric discomfort is closely related to the symptoms produced by balloon distention of the upper jejunum and is probably caused by the rapid inpouring of extracellular fluid into the small bowel, with distention, hypermotility, and possible regurgitation into the stomach remnant. It is possible that the only patients after subtotal gastrectomy who do not have any postprandial disturbance are those who are fortunate enough to have an anastomosis which has developed a sphincter-like action, simulating the pylorus and preventing precipitate emptying into the small bowel.

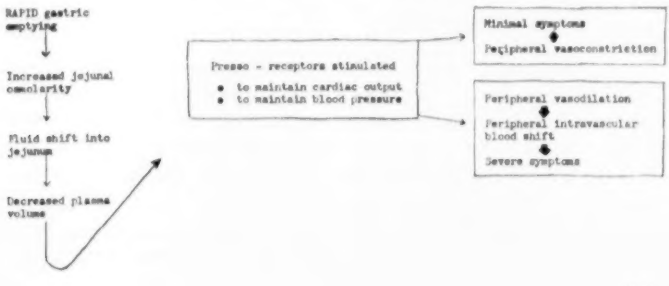
Table 4 summarizes our concept of the possible mechanism of the dumping syndrome. Special attention should be called to Case 1, who had severe dumping symptoms in which a feeling of warmth, syncope, and weakness were prominent. In this patient the maximum plasma volume reduction was 710 cc., and the peripheral blood flow was approximately 11 times the control value, which suggests an extensive intravascular peripheral blood shift. The remarkable changes in the studies after surgical conversion of a large stoma Billroth II-type gastric resection to a small-stoma end-to-side Billroth I are noteworthy. The maximum plasma volume reduction after surgical conversion was 250 cc., a reduction to nearly one-third of the preoperative value, while the change in peripheral blood flow was from 11 times the control to approximately 1½ times the control value, and the patient's symptoms of syncope, weakness, and warmth disappeared. This close correlation emphasizes the importance of both the plasma volume and the peripheral blood flow changes in the dumping syndrome.

Whether the vasodilatation which occurs in these circumstances is entirely an abnormal response of the sympathetic nervous system or whether some vasodilating agent is involved is not clear. Studies are in progress to attempt to settle this question.

Summary and Conclusions

The dumping syndrome is a symptom complex appearing in some patients after gastric resection; it is characterized by epigastric discomfort, nausea, palpitation, tachycardia, weakness, syncope, often a feeling of warmth, and sometimes explosive diarrhea.

TABLE 4.—*Suggested Mechanism of the Dumping Syndrome*



Rapid gastric emptying results in intrajejunal hyperosmolarity, with a compensating shift of extracellular fluid and plasma into the jejunal lumen to achieve isotonicity. Consequently, a reduction in circulating plasma volume occurs.

Evidence is presented to show that increased peripheral blood flow is present in many patients with dumping symptoms.

It appears that the increased peripheral blood flow is closely related to the systemic symptoms of the dumping syndrome, such as syncope, tachycardia, and weakness.

It is suggested that patients who exhibit severe systemic manifestations in dumping attacks have abnormal homeostatic vascular responses to sudden reductions in plasma volume.

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The Effect of Gastroenterostomy on the Gastrin Mechanism

EDWARD R. WOODWARD, M.D.; MOHAMED FATHY EL GEZIRI, M.B.; HERBERT SCHAPIRO, M.S., and L. F. PLZAK, B.S., Los Angeles

During the first quarter of this century simple gastrojejunostomy was considered by many to be the surgical treatment of choice for duodenal ulcer; its technical ease, combined with low operative risk, was a prime factor leading to its extensive use. It was some years before it was realized that the rate of marginal ulceration was very high, probably in the neighborhood of 40%. As a result of this observation, the operation fell into disrepute and was not often used as the sole procedure in treating duodenal ulcer. Since the marked interdigestive hypersecretion of acid gastric juice characteristic of the patient with duodenal ulcer is unaltered by gastroenterostomy, it is surprising indeed that approximately 60% of such patients seemingly remained well.

After the introduction of vagotomy for the treatment of duodenal ulcer in 1943,[1] gastroenterostomy as an ancillary procedure was found useful in promoting more adequate gastric drainage. A small number of patients thus treated developed recurrent peptic ulcer, even though laboratory investigations disclosed that the nervous phase of gastric secretion was entirely absent.[2] In Heidenhain-pouch dogs the creation of a gastrojejunal stoma was found to cause a sharp increase in the secretion of acid gastric juice from the denervated fundic pouch, indicating excessive gastrin release from the pyloric antrum.[3,4] The stimulating effect of gastroenterostomy in these animal preparations could be obviated by prior resection of the gastric antrum.[3] One group of investigators found that the stimulus occurred when the jejunum was anastomosed to the body of the stomach, whereas, if the anastomosis was constructed in the antrum near the pylorus, excessive gastrin release did not appear.[3] Another group of workers did not find the location of the anastomosis to be of importance.[4] Since differences in stoma size might account for the variation in the results observed, it was decided to repeat the study while carefully controlling this factor. Since gastroenterostomy with or without vagotomy is considered by many to be a useful surgical procedure, it was hoped to establish technical criteria for a physiologically safe procedure.

Method

In eight dogs denervated fundic (Heidenhain) pouches were constructed in the usual fashion with the use of stainless-steel cannulas for gastric juice collection. After complete recovery from the surgical procedure, each animal was fed a standard, weighed diet, and the 24-hour secretion of gastric juice from the Heidenhain pouch was collected for 21 consecutive days. Gastrojejunostomy was then performed directly on the greater curvature, exactly 5 cm. proximal to the pylorus. The anastomosis was tailored to precisely 1 cm. in diameter. After recovery, the 21-day collection period was repeated under identical conditions.

At a third operation the gastrojejunostomy was extended equally in both directions in the gastric wall until the diameter had been enlarged to 4.5 cm. Again, after recovery, the 21-day observation period was repeated under standard conditions.

In one dog the gastroenterostomy was divided, the efferent loop was left anastomosed to the antrum and the afferent loop was implanted high in the fundus of the stomach. In this way alkaline duodenal contents were shunted perforce over the

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acid-secreting main stomach. In two additional dogs, with a wide (4.5 cm.) gastroenterostomy, the pylorus was divided, and a 21-day observation period was repeated.

In each gastric juice sample the volume was measured, and the free acid concentration determined by titration against Töpfer's reagent. The gastric juice secreted by the Heidenhain pouch was then recorded as milliequivalents of HCl per 24 hours. For purposes of comparison between the various periods, the average daily secretion was determined.

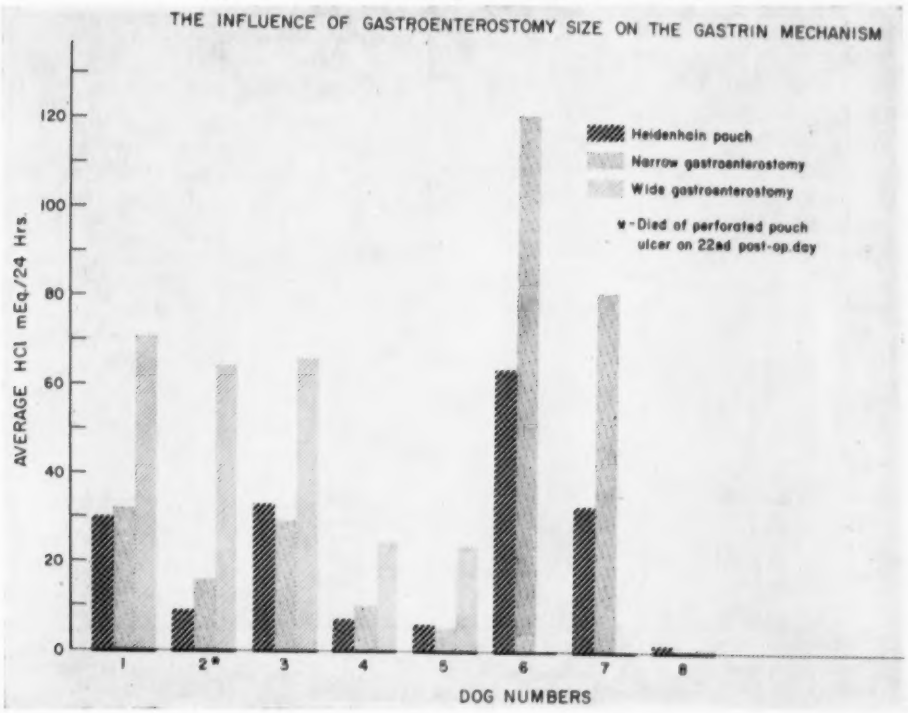
Results

Following construction of a small gastrojejunostomy near the pylorus, the average daily gastric secretion from the Heidenhain pouch remained unchanged in six of the eight animals (Fig. 1). In two animals, however, there was a sharp rise of 248% and 190%, respectively, in the HCl output of the isolated pouch, indicating a marked increase in gastrin production by the antrum. In both of these dogs the pouch secretion went to such high levels that peptic digestion of the mucous membrane occurred. One animal died of a perforated ulcer in the Heidenhain pouch, whereas the second died of subacute hemorrhage from a similar peptic ulcer. At autopsy both gastrojejunal anastomoses were the proper (1 cm.) size and in the proper location, i. e., near the pylorus.

When the small gastrojejunal anastomosis was converted from its 1 cm. diameter to a 4.5 cm. size, five of the six remaining animals showed a sharp rise in gastric secretion from the Heidenhain pouch (Fig. 1). This varied from 207% to 517% over the first two periods, averaging 346%. The sixth dog showed no increase in the Heidenhain-pouch secretion after either the small or the large gastroenterostomy. The isolated pouch secreted adequately, however, in response to subcutaneously administered histamine.

When the jejunal limbs of the gastroenterostomy were separated, forcing complete

Figure 1 (the asterisk belongs with Dog 6, not Dog 2)



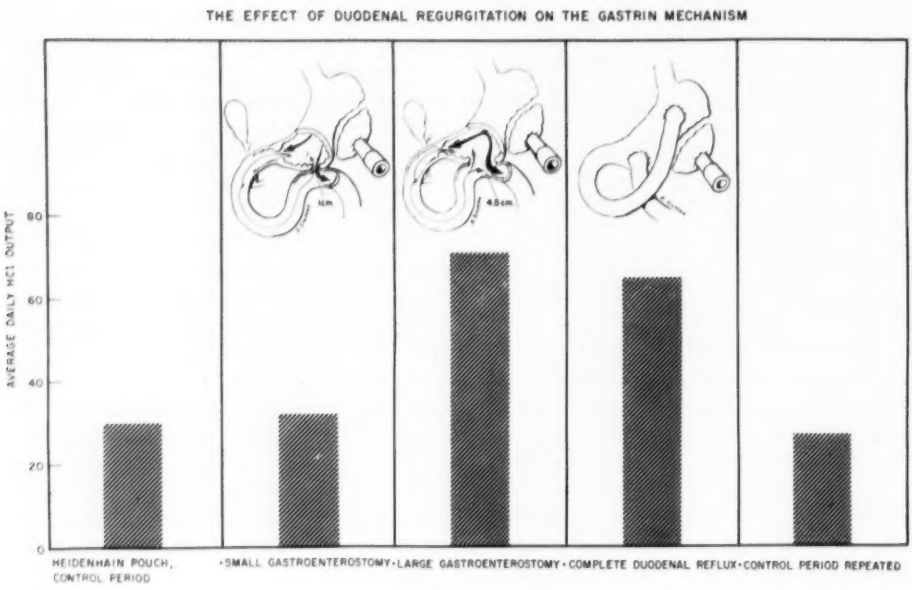


Figure 2

Figure 3

reflux of duodenal contents into the acid-secreting portion of the stomach, no increase in secretion from the Heidenhain pouch occurred (Fig. 2). One such experiment is admittedly insufficient for basing any conclusion on this observation.

When the pylorus was divided, the excessive secretion produced by the large gastroenterostomy disappeared, and the daily HCl output of the Heidenhain pouches returned to almost exactly the levels observed before gastroenterostomy. The result in one animal is demonstrated in Figure 3. The same result was obtained in the second animal; in addition, reanastomosis of pylorus and duodenum was followed by prompt return of a high level of pouch secretion.

Comment

In a Heidenhain-pouch dog creation of a small (1 cm.) gastroenterostomy in the antrum near the pylorus was usually not followed by an increase in the pouch secretion, indicating that the gastrin mechanism was not affected. This was not invariable; in two of the eight dogs there was a significant increase of 248% and 190%, respectively. When a large anastomosis was created in the same location, however, five of six animals showed a striking increase in pouch secretion, indicating excessive gastrin release.

Since pyloroplasty does not result in hyperfunction of the antrum in the experimental animal,[5,6] it would seem best, wherever possible, to use this operation rather than gastroenterostomy as an ancillary drainage procedure with vagotomy. Even though properly positioned and of small size, the gastroenterostomy may exaggerate gastrin release. Other studies indicate that the antrum of the human stomach functions very much like that of the dog.[7] It is probably sound, therefore, to apply these experimental findings in the clinic.

Simple gastroenterostomy is still utilized occasionally by some surgeons, particularly in elderly or poor-risk patients with obstruction. Some would be reluctant to use this method in a patient who had a high rate of basal gastric secretion. The marginal ulcer rate in such cases, however, seems to be remarkably low. The presence of pyloric obstruction may be an important factor; in the experiments reported, division of the pylorus completely obviated the stimulating effect of a large gastroenterostomy on the gastrin mechanism. One can only speculate as to the mechanism for this interference; either reflux of alkaline duodenal juices through the pylorus or the "circus" motion of these fluids through the afferent loop and antrum or both may be important.

The development of high gastric acidity is a normal requirement for the termination of gastrin release by the antrum after chemical or mechanical stimulation.[8,9] It seems likely that gastroenterostomy exaggerates gastrin release by interfering with this normal regulatory device. With the creation of a small anastomosis, there is probably less reflux of alkaline duodenal secretions than when the anastomosis is large, and this most likely accounts for the importance of size. A high-lying anastomosis allows pooling of refluxed alkaline duodenal juices in the distal portion of the stomach, which, in turn, allows hyperstimulation of the antrum by ingested food. Therefore, in the peptic ulcer patient gastroenterostomy should be placed in the dependent portion of the stomach near the pylorus and should be made of small size, probably slightly less than the diameter of the jejunum.

Summary and Conclusions

In eight dogs Heidenhain pouches were constructed to serve as an indicator of gastrin release from the pylorus antrum. The daily pouch secretion was measured under standard conditions, and then a small gastroenterostomy was performed on the greater curvature, 5 cm. from the pylorus and 1 cm. in diameter. In six of the animals there was no change in the pouch secretion, indicating no effect on the gastrin mechanism. In two animals there was an increase in gastric secretion by the pouch, measuring

248% and 190%, respectively. When the gastrojejunostomy was enlarged to 4.5 cm. in diameter, all but one animal demonstrated a striking increase in acid output from the pouch, averaging 346% and indicating excessive gastrin release. When the jejunal limbs of the gastroenterostomy were separated, forcing complete regurgitation of all alkaline duodenal juices into the stomach, gastrin formation did not increase further.

It is concluded that the size of an anastomosis is an important factor in the stimulating effect of gastroenterostomy on the gastrin mechanism. It is recommended that, when used, the gastroenterostomy not only should be placed in the dependent portion of the stomach near the pylorus but also should be constructed of small size.

In two Heidenhain-pouch dogs with large gastroenterostomies, transection of the pylorus was followed by return of pouch secretion to normal control levels. This supports the conclusion that gastroenterostomy may be a safer procedure with less likelihood of antral hyperfunction and marginal ulceration in patients with pyloric obstruction.

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DISCUSSION

ON PAPERS BY DRS. BRUSH, BLOCK, GEOGHEGAN, ENSIGN, AND SIGLER; DRS. WALTERS AND LYNN; DRS. HINSHAW, JOERGENSON, DAVIS, AND STAFFORD, AND DR. WOODWARD AND MESSRS. EL GEZIRI, SCHAPIRO, AND PLZAK

DR. EDGAR JACOB POTH, Galveston, Texas: I should like to discuss primarily the paper of Drs. Hinshaw, Joergenson, Davis, and Stafford, although these remarks apply to the problem in general.

It seems evident that the dumping syndrome is precipitated by the introduction of sufficiently large quantities of hypertonic solutions or readily digestible foods (carbohydrates) into the jejunum. If the hypertonicity is not great or if the quantity is small, the phenomenon does not occur.

The inclusion of carbohydrates in the diet is highly desirable, and they can be incorporated if they are impregnated with fats, thereby making their exposure to the water-soluble digestive ferment no more rapid than the separation of the impregnating fats. This procedure works well, but all patients do not tolerate well this relatively crude diet, including the forcing of fluid between and just preceding meals.

There is a surgical approach. The construction of a substitute pouch of sufficient capacity which will act as a true reservoir, allowing prolonged emptying in a piecemeal fashion. The principle involved is the insertion of a physiological valve mechanism in the form of a reversed segment of

jejunum. These slides will illustrate four modifications of the procedure with total or subtotal gastrectomy either utilizing or bypassing the duodenum. The third slide illustrates the manner in which an ordinary Hofmeister resection can be converted to incorporate the principle of the reversed segment. The length of this antiperistaltic segment apparently is not critical and can vary considerably.

These pouches empty piecemeal over a period of three to six hours. The patients eat well, and "dumping" does not occur when high carbohydrate meals designed to cause the syndrome are fed.

[Slide] This first slide illustrates the principle which is involved. An isoperistaltic segment of jejunum is sutured to the esophagus. This maneuver is important to prevent regurgitation into and irritation of the esophagus. The antiperistaltic loop of jejunum is placed just ahead of the duodenum in this instance.

[Slide] The next slide illustrates the modifications, depending upon whether the duodenum is included or excluded. Where a residuum stomach pouch remains, the length of the antiperistaltic segment needs to be longer than illustrated on this slide if emptying is retarded.

[Slide] The next slide demonstrates the manner in which an ordinary Hofmeister gastric resection can be converted in the patient who is dumping. The stomach pouch can be converted very simply into one incorporating the antiperistaltic mechanism.

DR. JOHN MCM. WAUGH, Rochester, Minn.: Dr. Joergenson asked me yesterday if I would discuss this paper on the dumping syndrome.

I am very happy to do so, and I want especially to congratulate him and his co-workers on the very interesting contribution to our knowledge of this subject.

Dr. Custer, who was one of the Fellows in General Surgery of the Mayo Foundation, made a careful evaluation of our cases about 1945, and it seemed at that time that, when the Hofmeister operation was used, the number of "permanent dumpers" was about one-third of that seen with the Polya operation. However, we did not publish this, because it is such a difficult problem to be sure about these patients, their symptoms are subjective many times, and I did not feel that the study was controlled carefully enough to be recorded in the literature. Also, at that time we asked Dr. Grace Roth, of our Peripheral Vascular Laboratory, to study some of these patients, because their vasomotor symptoms are so striking, hoping that light could be shed on the cause and treatment of dumping. However, when they were in the laboratory, we could not always reproduce the typical dumping syndrome, as it is difficult to find patients who will have uniform symptoms.

I think the investigators should be congratulated on being able to devise this experiment so that it was uniform and could be carefully controlled.

They did not have time to mention whether the meal was the same. I am sure that it was, but probably in the discussion that follows they can emphasize the fact that the meal after the Billroth I operation was the same as the meal before, because a change in the meal content will make considerable difference.

Dr. Snell called these patients who have permanent dumping "gastric cripples." Fortunately, only about 1% or 2% of the patients end up in this fashion after subtotal gastrectomy, and most of the time the syndrome seems more frequent in women. However, there are many men who also have minor symptoms, and on careful questioning of these patients after subtotal gastrectomy, regardless of the type that is done, one will find that a high percentage will have the syndrome for a time and then seem to learn how to live with it.

I know that several of our members have had it and can speak very feelingly about this syndrome.

We have found that one sees this after a gastroenterostomy, for instance, as well as after the other types of resection, and that it will follow even resection and vagotomy or gastroenterostomy and vagotomy.

There is no one procedure that will promise relief of the dumping syndrome. We have found that it appears almost as frequently after the Billroth I as after the Billroth II modification. It seems that cutting down on the size of the stoma is helpful in those patients who are severe dumpers, and this may explain the lower incidence we found after the Hofmeister as compared with the Polya operation. I have one patient in whom I interposed a jejunal pouch; it seemed to be effective for a few months, and then, unfortunately, the patient appeared to have about as much in the way of symptoms as he had before. However, the movement was isoperistaltic and not antiperistaltic, which was indicated by Dr. Poth to be more desirable.

DR. TILDEN C. EVERSON, Chicago: The paper of Drs. Walters and Lynn emphasizes that the great majority of patients subjected to the Billroth II type of partial gastrectomy for peptic ulcer do have satisfactory results.

My associates and I have recently completed a study of some 348 patients with peptic ulcer subjected to the Billroth II type of partial gastrectomy during the period 1946-1954 at the Hines Veterans Administration Hospital and the University of Illinois Research and Educational Hospitals. In this series the postoperative mortality rate was 4.9%. However, the mortality rate was greatly

weighted by the fact that acute hemorrhage was the principal indication for surgery in an appreciable number of patients. When the principal indication for surgery was pain, the postoperative mortality rate was 0.9%. Recurrent ulceration proved by surgery and/or roentgenograms was noted in 2.2%, and presumptive recurrent ulceration (hematemesis and/or characteristic ulcer pain) was noted in 1.7% of 231 patients followed after partial gastrectomy.

Of the patients subjected to partial gastrectomy, 14.9% were above their preoperative average healthy weight at the time of follow-up, with an average gain of 10 lb. Six and three-tenths per cent of the patients had no change in weight, and 78.8% of the patients were below their average healthy weight at the time of follow-up, with an average loss of 17 lbs.

At least minimal symptoms of the dumping syndrome occurred in 50.3% of the patients after partial gastrectomy. (In this study the diagnostic symptoms of the dumping syndrome were considered to be weakness, sweating, or dizziness occurring during a meal or within one hour after the meal. The presence of any of these symptoms even to a slight degree, as established by direct leading questions, was accepted as evidence of the presence of the dumping syndrome.)

Of surviving patients followed after the Billroth II type of partial gastrectomy, 92.6% were satisfied with the results of the operation at the time of follow-up. However, when patients who died in the postoperative period are included as dissatisfied patients (which they obviously must be), the percentage of satisfied patients was reduced to 86.3%.

With respect to the Billroth I type of partial gastrectomy for duodenal or gastric ulcer, my personal series consists of some 60 cases. Many of these operations have been performed in the past three years. I have been favorably impressed with the results after the Billroth I operation and have felt that the nutritional status was possibly less distrubed than after the Billroth II operation. At the present time I do not have any proved recurrences in the Billroth I group. However, the series is small, and the follow-up period in many cases has been short. I would agree with Dr. Harkins, however, that it is important to have confirmation of the extent of gastric resection by objective measurement and that this is probably even more important with a Billroth I type of gastrectomy.

Dr. Charles Puestow, Chicago: I should like to make one brief remark relative to Dr. Brush's presentation. I have just been informed by our Assistant Chief of Surgery that of the last 24 patients admitted to the hospital because of massive hemorrhage from duodenal ulcers, all of which required surgical intervention, 19 were on steroid therapy at the time they developed their hemorrhage. This is only one of the complications of steroid therapy, which increases the hazards of surgical patients. We have instructed our residents, when taking histories, always to inquire if the patient has been on steroid therapy, so that adequate precautions may be taken to minimize the danger of complications due to, or intensified by, this form of therapy.

I believe one should be reluctant to use steroid therapy in ulcer patients, unless no other form of therapy is satisfactory, and one should be cognizant of the danger of the production of hemorrhage.

Dr. G. Arnold Stevens, Beverly Hills, Calif.: The recent observations of my associates and me support the results presented in the paper of Drs. Walters and Lynn. In our experience involving Billroth I procedures combined with vagotomy, it has been necessary to replace more than 9% of these with subsequent gastrojejunal anastomoses. These results have been further supported by Goligher and his associates in London (*Lancet* 1:229, 1956). In a three-year follow-up there were 17% proved and suspected recurrent duodenal ulcers following extensive Billroth I resections, in contrast to only 2% marginal ulcers following the Polya type of procedure during this same period.

Certain theoretical considerations are consistent with these results.

It is true that in dogs the duodenum is more resistant to acid than is the jejunum. This is probably true in humans also, although there is no proof of this. However, with the Billroth I procedure, duodenal regurgitation is spasmodic only, and neutralization of the potential ulcer area in the anastomosed duodenum therefore is not constant. On the other hand, the jejunal stoma in a Billroth II or a Polya procedure is more or less constantly bathed with alkaline juices.

Theoretically, fat digestion should be aided by food passing through the duodenum. However, in our series we have encountered little or no evidence of clinically disturbing fat indigestion associated with the Polya operation.

In a Billroth I procedure, as usually constructed, the gastric contents strike the duodenum in relatively the same place as they did before, and it is at that place that most recurrent ulcers form.

Furthermore, the Billroth I operation is technically not feasible in cases where the duodenum is unduly friable. In a significant number of cases, it implies the useless and risk-increasing resection of the ulcer. This is unnecessary in the Polya or Billroth II procedures.

Dr. James T. Priestley, Rochester, Minn.: This has been a most interesting and informative group of papers. Detailed studies of this type are essential, but it is also important that we keep

certain broad concepts in mind regarding the treatment of duodenal ulcer. Because of this fact, my remarks will be of a general nature, rather than strictly limited to the paper presented by Drs. Walters and Lynn, as I had intended.

First, one might ask: What are the objectives of operation for duodenal ulcer? Obviously, the immediate ideal postoperatively is a living patient who will experience a smooth convalescence, but, from a long-range viewpoint, the prime objectives are relief of the symptoms and complications of ulcer, a patient who can eat with pleasure and can maintain a satisfactory nutritional status, and prevention of recurrence of ulceration. I think that in recent years, and especially in this country, the prevention of recurrent ulcer at times has become almost the single criterion in the evaluation of surgical results. Obviously, prevention of return is of great importance, but it is not the only consideration.

The one point I wish to stress is that, to obtain the best results for the most patients, it is necessary to choose the particular type of operation best suited for the individual patient, rather than to perform the same type of operation on all patients. There are many variables among patients with duodenal ulcer, including age, type of symptoms, nutritional status, amount of gastric secretion, activity of the ulcer, location of the ulcer, and others. In my opinion, these factors must be taken into consideration in the choice of the type of operation best suited for the individual patient. Not all patients need the same amount of reduction in gastric acidity to effect cure of the ulcer and to prevent recurrence. Again, some patients do not tolerate high gastric resection as well as others do.

Today, we have a variety of operations available for the treatment of duodenal ulcer, which offer varying degrees of physiologic effects, present diverse technical difficulties, and permit varying types of removal of anatomic structures and anatomic rearrangement. It seems inadvisable for all of us to abandon standard procedures each time a new operation is suggested, until the true worth of the innovation has been evaluated by those who originated it. If gastric resection is performed—assuming that it is a satisfactory operation, both technically and physiologically—I am inclined to believe that it is not a matter of great importance whether gastroduodenal or gastrojejunal anastomosis is established.

As I have said, my main point is that the operation best suited to the individual patient is the one that should be selected.

DR. ROBERT M. ZOLLINGER, Columbus, Ohio: Dr. Joergenson and his associates are to be congratulated on this excellent and thought-provoking paper. The dumping syndrome is a real problem to a definite per cent of patients, regardless of the type of gastric operation performed. The studies of Randall, which showed an altered plasma volume in connection with the dumping syndrome, represent one of the most important contributions to this subject in the past several years. Like the authors, we have utilized this test, and we have found it valuable, especially when there was some question as to the validity of the patient's symptoms. In other words, were they real or imaginary?

We have studied the plasma volume shift in 77 cases, utilizing the technique mentioned by the authors. [Slide] In this slide you will observe that in control patients, as well as postoperative gastric cases classed as nondumpers, there was a plasma volume shift of less than 10% following the administration of 75 gm. of dextrose by mouth. There were only 15% of the nondumpers who violated this rule. On the contrary, three-fourths of the patients with the dumping syndrome had a plasma volume shift of greater than 10%. In fact, some showed a shift of one-fifth of their plasma volume. Yet, it is also apparent that there is disturbance of some type in nearly all cases of gastric surgery with or without dumping, since our controls are consistently much lower than even the nondumpers. We have always assumed that this loss involves the upper small bowel, which is valiantly trying to neutralize the hypertonic solution.

We agree with the authors that such shifts are not great enough to explain the clinical symptoms in all cases, and their suggestion that there is pooling of blood in the lower extremities is an important observation.

We have tended to explain some of the discrepancies by the fact that some patients have marked hyperperistalsis to the point of a rather severe diarrhea following the ingestion of dextrose. [Slide] The second slide suggests that this may have an effect on the absorption of dextrose and, in turn, an effect on attempts to dilute the rapidly passing small bowel contents. On the left of the slide you will observe a high and rapid rise in blood sugar with a plasma volume shift of 15%. On the right is a low normal type of blood sugar curve in a severe dumper. Here the shift is only 2.5%.

Certainly the studies presented this morning will stimulate those of us interested in this problem to look further than the gastrointestinal tract for the explanation of the dumping syndrome.

Since it has been reported than an electrocardiograph tracing may be altered immediately after a meal, it is interesting to note that neither the authors nor anyone else has observed postprandial angina in association with the dumping syndrome. In the presence of such gross changes in blood

volume and distribution, it could be expected that certain borderline cases of coronary sclerosis or angina pectoris might be noted in conjunction with dumping symptoms.

DR. EUGENE JOHN JOERGENSON, Glendale, Calif.: In answer to Dr. Waugh's question, the patients that were observed would show the same condition before and after their surgical interventions. I should just like to say that this peripheral shift is not well understood. Whether it is response to the vasomotor system or to some agent, we do not know, but I was impressed with the similarity of symptoms that many of these dumpers exhibited compared with symptoms that Dr. Gonzales reported yesterday. Patients with carcinoids of the ileum should certainly be investigated.

This response seems to be an individualistic one, and if we could find ways and means of detecting the responses before patients are submitted to gastric resection, we would make a real contribution toward helping persons with gastric ulcer.

A Case of Islet-Cell Carcinoma of the Pancreas Associated with Peptic Ulceration f the Jejunum

FRANK F. BUSTEED, M.D., and EDWARD B. SPEIR, M.D., Seattle

Carcinoma of the pancreatic islet cells remains a very unusual tumor. There are few reports of attempted resection. The case report which follows concerns a 37-year-old white man who has remained well for two years and three months after resection of the stomach and pancreaticoduodenectomy for a nonfunctioning metastasizing islet-cell carcinoma of the pancreas with associated jejunal ulceration.

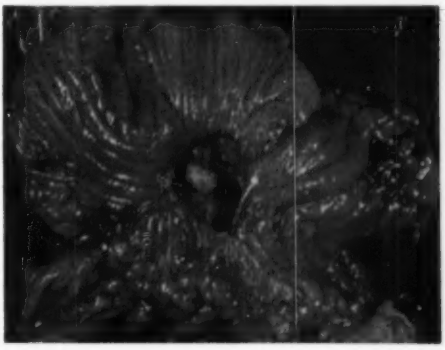
Report of Case

A 37-year-old white male farmer was admitted to the hospital in August, 1954, with complaints of itching skin and pain in the upper abdomen. One year previously a subtotal gastrectomy and gastrojejunostomy were done for an ulcer in the first part of the duodenum. His convalescence was without incident, and he remained well for a period of about eight months. He then began having burning epigastric pain, and shortly thereafter a marginal ulcer was demonstrated by x-ray examination. Jaundice was first noted two months before admission, and about the same time the patient began to lose weight. Three weeks before admission he was hospitalized elsewhere because of a severe gastrointestinal hemorrhage. At that time he received six whole blood transfusions which resulted in an elevation of the hemoglobin from 58% to 92%. The icterus index, however, rose progressively through seven serial determinations from 47 to 180 units. At the same time the cephalin-flocculation test remained negative. The serum alkaline phosphatase was not determined, but the jaundice was felt to be obstructive and in some way related to the demonstrated ulcer. The patient's upper abdominal distress continued throughout the hospitalization, and he had pain penetrating through to his back as well as frequent spells of nausea and vomiting. He was transferred for treatment and entered the Providence Hospital on Aug. 23, 1954.

Course in Hospital.—On admission, the blood pressure was 140/90; pulse, 60; respirations, 20, and temperature, 99.4 F. The patient was a thin white man who was intensely jaundiced and had numerous excoriated areas over his trunk and extremities where he had scratched. The chest was clear, and the heart rhythm was regular. There was tenderness in the epigastrium but no rebound tenderness. The liver was 3 cm. below the costal margin, but no other masses were palpable. Peristalsis was present. There was no rectal shelf or rectal mass, and there was no lymphadenopathy. The admission urine was dark. The hemoglobin was 16.1 gm. per 100 cc. The white blood cell count was 6500, with a normal differential count. Icterus index, 120 units. Prothrombin concentration, 100%.

On Aug. 24, 1954, an upper gastrointestinal x-ray examination demonstrated a stomal or jejunal ulcer. On Aug. 25, a sodium iodipamide (Cholografin) study failed to show opaque medium in any part of the biliary tract. On Aug. 26, the patient was taken to surgery, where he was found to have a tennis-ball-sized nonfixed rubbery rounded tumor mass presenting anteriorly in the head of the pancreas. There was a large marginal ulcer, approximately 2 cm. distal to the gastrojejunostomy, in the efferent jejunal limb. There

Fig. 1.—Resected old gastrojejunal anastomosis showing marginal ulcer in the efferent limb of the jejunum.



Former Resident in Pathology, Providence Hospital (Dr. Busteed).

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 29, 1956.

was a marked inflammatory reaction involving the mesenteries of the jejunum and transverse colon, with enlarged lymph nodes immediately adjacent to the ulcer. The liver was a sick-appearing organ, mottled brown, the result of two months' obstruction of the pancreatic portion of the common bile duct by the tumor. The gallbladder was distended but contained no stones. The common duct was dilated to approximately 2.5 cm. in diameter. There were no visible or palpable metastatic nodules in the liver. The spleen was normal in size. The general peritoneal cavity, including the pelvis, was free of evidence of metastatic disease.

As one-stage duodenectomy, subtotal pancreatectomy, and resection of the stomach including the gastroenterostomy with the marginal ulcer were accomplished. The tail of the pancreas, approximately 5 cm., was left in situ. Continuity was reestablished by an end-to-end anastomosis between the common duct and the jejunum. The pancreatic remnant was anastomosed end-to-side into the jejunum, and some 10 cm. below this a new gastrojejunostomy completed the issue. The abdomen was closed in layers without drainage.

The patient received three units of blood during and after surgery, and his immediate postoperative condition was fair. Continual gastric suction was instituted, and fluid and electrolyte losses were replaced. The blood glucose level remained between 105 and 153 mg. per 100 cc. The patient was ambulatory on the sixth postoperative day and was discharged on the ninth postoperative day.

The jaundice cleared shortly after he left the hospital, and for two years and three months the patient has remained well. He has regained his normal weight, of 145 lb. He has no complaints, and he has been able to carry on his regular duties. He does not require insulin, nor has he received any other medication. Clinically there is no evidence of recurrent tumor.

Pathological Findings.—The surgical specimen was received in two parts. The first consisted of the old gastrojejunal anastomosis, including about a 4 or 5 cm. segment of stomach anastomosed to a loop of the jejunum. Two fingers could be admitted from the stomach into the jejunal lumen with fair ease. The jejunal loops were each 15 cm. in length and 5 cm. in diameter, reddish, smooth, and edematous. The mucous membrane was the seat of a tremendous ulcer near the anastomosis with the stomach. The nearest edge of the ulcer was 1.5 cm. distal to the anastomosis, so that the ulcer actually existed only in the jejunal mucosa and wall. It was an oval, deep, penetrating ulcer, measuring 3.5 by 2.5 cm. In the mesentery of the jejunal loop there were a number of lymph nodes, the largest being 2.8 cm. in diameter.

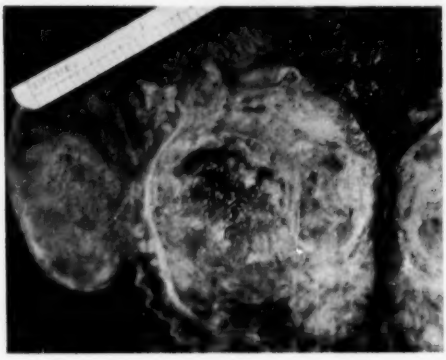


Fig. 2.—Islet-cell carcinoma of the pancreas with polypoid extension into the duodenum.

The second part of the specimen consisted of the head and body of the pancreas, the second and third portions of the duodenum, and a small segment of the proximal jejunum. In the head of the pancreas, in apposition to the wall of the duodenum, was a soft bulging yellowish-gray tumor, 6.5 cm. in diameter. The duodenal mucosa distal to the ampulla of Vater showed no change. The 6.5 cm. segment of duodenum proximal to the ampulla was closed and constituted the old duodenal stump from previous gastric resection. A most interesting, externally smooth, glistening, oval-shaped, rather soft mass projected into the lumen of the duodenum just anterior to the papilla. The diameters of the intraduodenal mass were as follows: 4.5 cm. in the duodenal axis; 2.5 cm. in height, and 3 cm. in width. This odd structure arose from the wall of the duodenum in apposition to the mass in the pancreas. There was about 2 cm. of duodenal mucosa between the papilla and the nearest border of this mass, and projecting into this mucous membrane was a small raised yellowish body, 1.5 cm. in diameter. The common bile duct was 7 cm. long. It passed close to the right lateral aspect of the pancreatic neoplasm and, though compressed, did not appear invaded by it. Sections through the tumor in the duodenum and pancreas showed the tissue in each instance to be moderately firm and grayish to yellowish-white. The muscularis seemed to persist between the duodenal and pancreatic parts of the tumor. A single lymph node just inferior to the pancreatic neoplasm appeared to contain tumor. In the same region a blood vessel, about the size of a lead pencil, seemed to have tumor in the lumen.

Microscopically, most of the cells were dispersed in broad irregular sheets, and the remaining cells, in narrow solid cords; these formations were separated by delicate to thick fibrous connective tissue trabeculae. The cytoplasm was abundant, pink, and sometimes vacuolated. The

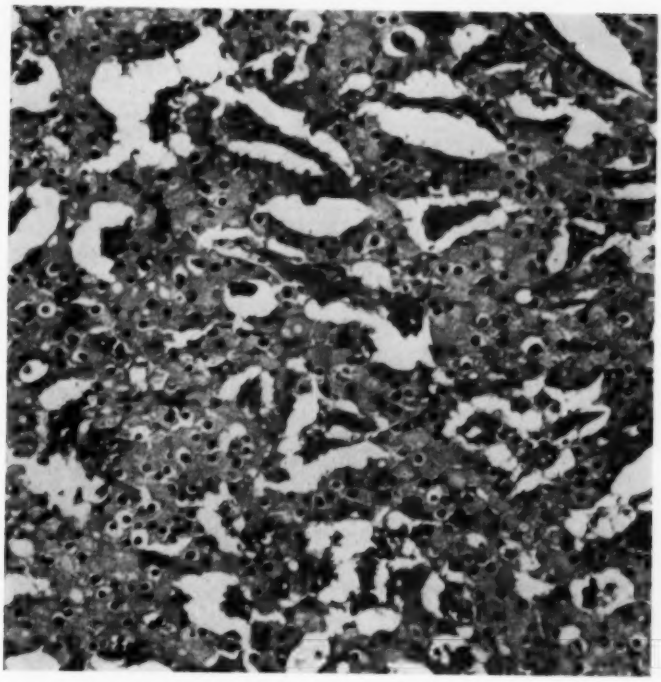


Fig. 3.—Islet-cell carcinoma of the pancreas (primary tumor).

nuclei were of small to medium size and were usually vesicular, with a single, rather prominent nucleolus. Mitotic figures were infrequent. Numerous groups of tumor cells were present in small- and medium-sized blood vessels and lymph channels, and the single lymph node adjacent to the tumor in the head of the pancreas was filled with tumor cells. Therefore, this tumor may be

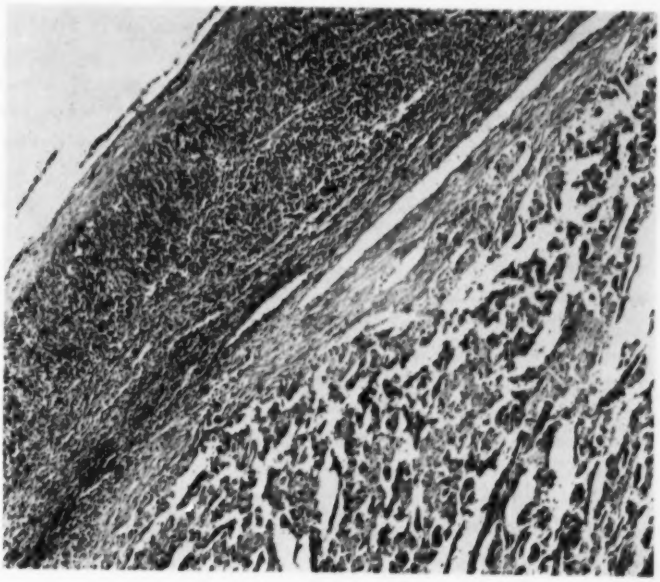


Fig. 4.—Islet-cell carcinoma of the pancreas, metastatic to regional lymph node.

Malignant Islet-Cell Tumors Resected

Author	Operation	Metastases	Postoperative Survival
Joachim & Banowitch [1]	Partial resection of tumor and splenectomy	Regional lymph nodes	6 wk.
Whipple [2]	Pancreaticoduodenectomy	Liver	10 yr.
Brunschwig [3]	Resection of tumor	Liver	3 yr. 11 mo.
Gray [4]*	Resection of tumor	Liver	6 wk.
Nadal [5]	Pancreaticoduodenectomy	Liver	8 yr. 2 mo.
Sailer & Zinninger [7]	Resection of tumor	Liver and urinary bladder	3 yr. 10 mo.
Ellison [10]	Resection of body and tail of pancreas	Liver	4 yr. 6 mo.
Ström [14]	Resection of tail of pancreas	Regional lymph node	Living and well 3 yr. 6 mo.
Zollinger & Ellison [12]	Excision of tumor, total gastrectomy	Regional lymph node	Living and well 2 yr. 6 mo.
Shaw [15]	Resection tail of pancreas, spleen, and great omentum	Regional lymph node	Living and well 2 yr. 6 mo.
Busteed & Speir	Pancreaticoduodenectomy	Regional lymph node	Living and well 2 yr. 3 mo.

* Also reported by Marble & McKittrick.[6]

classified as malignant. The jejunal ulcer and the numerous mesenteric lymph nodes did not contain tumor. Diagnosis: Primary islet-cell carcinoma of head of pancreas with extension to the duodenum; extensive blood vessel invasion and metastasis to a single regional lymph node; postoperative jejunal or marginal ulcer, and neoplastic compression of common bile duct.

The literature has revealed 10 cases where surgery was directed toward the resection of a verified malignant tumor arising from the islets of Langerhans. In two of the cases the postoperative survival was less than two months. Five patients survived from 3 years and 10 months to 10 years after extirpation, or partial extirpation, of the tumor. Three cases were living and well. These cases appear in the Table.

The criterion used for classifying these tumors as malignant was the presence of demonstrable metastases. Frantz [8] drew attention to the fact that there is a group of islet-cell tumors which appear malignant but which after surgical removal do not show evidence of metastases, and the patients remain well. These localized tumors may show absence or invasion of the capsule, blood vessel invasion, cellular anaplasia, or numerous mitoses, alone or in combination. Frantz called such tumors "suspiciously malignant." Duff [9] felt that it was unnecessary to create a special category for these questionable tumors and considered them benign. Howard, Moss, and Rhoads,[10] in a collective review of islet-cell tumors, listed 37 cases which they considered malignant, using as their criterion the presence of metastases. Successful surgery has been carried out in numerous cases of adenomas and in many cases of questionably malignant tumors, some of which invaded surrounding structures but did not metastasize. Warren [11] recently reported the case of an 11-year-old girl from whom he removed an islet-cell tumor which had extended to the duodenal mucosa. She was alive and well two years and two months after pancreaticoduodenectomy.

There have been several reports of the simultaneous occurrence of non-insulin-producing islet-cell tumors, gastric hypersecretion, and peptic ulcerations of the second or third parts of the duodenum or recurrent stomal ulcers after gastric surgery. Zollinger and Ellison,[12] first described this combination of findings as a new clinical entity, ascribing an ulcerogenic potential to certain non-beta-cell tumors of the pancreatic islets. Ellison,[13] in a review of published cases and autopsy records, brought the total number of reported cases to 24. Our case appears to be another one which fits into this new clinical entity.

In summary, we present a case of non-insulin-producing metastasizing islet-cell carcinoma of the pancreas associated with peptic ulceration of the jejunum. The tumor was successfully removed surgically. The patient is well two years and three months postoperatively, working, requiring no medication, and presenting no clinical evidence of disease at this time.

Medical and Dental Bldg., 509 Olive Way (1) (Dr. Speir).

DISCUSSION

DR. CONRAD JOHN BAUMGARTNER, Beverly Hills, Calif.: This interesting case report by Dr. Speir is in some ways similar to one which Dr. Reynolds and I presented before this Association in Colorado Springs in 1954. We have had numerous inquiries as to the final outcome of this patient, and I should like to give you a follow-up report at this time.

Our paper was entitled "Functioning Metastases from Islet-Cell Tumor of the Pancreas: Control Corticotropin with (ACTH)." In brief review, this patient had a partial resection of the pancreas and splenectomy for islet-cell carcinoma in May, 1952.

[Slide] There was no ulcer present at this time. The first symptoms of hyperinsulinism appeared one year later. At exploration in October, 1953, the pancreatic bed was normal, but there were liver metastases, and now an acute duodenal ulcer was present. A vagotomy was performed. Hyperinsulinism was uncontrollable until we placed the patient on corticotropin. This controlled her condition up to the time of our report, in December, 1954.

In February, 1955, although the patient was in excellent nutritional state, her hypoglycemia became increasingly difficult to control. The corticotropin dosage was increased, and the situation was climaxed by an acute perforation of the duodenal ulcer, necessitating reoperation.

We found an enormous hole in the duodenum, metastases in the liver about the same, and again a normal pancreatic bed. We elected to remove the remainder of the pancreas and duodenum.

[Slide] We were elated to find a smooth postoperative course, and we obtained several normal fasting blood sugar tests. We were anxiously looking forward to studies of the insulin output of the liver metastases, but on the 20th day the patient developed wound separation, a gastric fistula, and generalized peritonitis, to which she succumbed 3 days later. A postmortem examination showed numerous metastic nodules in the liver.

[Slide] There were no involved nodes around the pancreatic bed. The adrenals weighed 29 gm., twice normal weight, and there was complete separation of all suture lines.

Notwithstanding reports to the contrary, we felt that the prolonged use of massive doses of repository corticotropin injection (ACTH Gel) not only accounted for the perforation of the duodenal ulcer but also was a factor in the failure of wound healing.

DR. R. D. WILLIAMS, Columbus, Ohio: The Department of Surgery at the Ohio State University has been quite interested in islet-cell tumors of the pancreas, particularly those associated with peptic ulceration. Over the past eight years, four cases have come under our observation.

I should like to show two slides which demonstrate some of the observations in 47 cases collected from the literature and from personal communications.

[Slide] The first slide shows, on the left side, the usual location of peptic ulcerations and, on the right side, unusual locations.

You will note that one out of three patients with tumors of the pancreas, islet-cell tumors, had their ulcerations in an unusual location, that is, distal to the duodenal bulb, and that multiple ulcers were noted in one out of six patients.

[Slide] The second slide shows the location of the reported tumors of the pancreas. You will note that two-thirds of these tumors occur in the left half of the pancreas and, therefore, are readily amenable to surgical excision. Also, interesting to note is the fact that, as in the case just presented, more than half, or 60%, of these tumors are malignant.

It is our feeling that a definite syndrome of marked stimulation of the gastric glands, with hypersecretion and peptic ulceration, may be associated with some unknown factor with islet-cell tumors of the pancreas. We, therefore, believe as a result that the pancreas should be explored at any time a surgical procedure is being carried out for peptic ulceration.

If the ulceration is in an unusual location or if there is a recurrence of ulceration after an adequate surgical procedure, then an islet-cell tumor should be suspected. If there is recurrent ulceration, it seems feasible to resect the body and tail of the pancreas on a suspicion of tumor, which may not be palpated because it is small, or on a suspicion of general hyperplasia of the islet cells.

If, on the other hand, after adequate resection of the left half of the pancreas there continues to be recurrent ulceration, we feel that total pancreaticoduodenectomy is not as acceptable from the patient's standpoint as total gastric resection. If the tumor is definitely malignant, as it was in this case, total pancreatectomy will be required, since the functioning metastasis may continue to produce hypersecretion.

We certainly hope there will continue to be reports on the case just presented, which will substantiate or refute our impression that certain islet-cell tumors of the pancreas are ulcerogenic.

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Primary Tumors of the Small Bowel

E. LEE STROHL, M.D., and WILLIS G. DIFFENBAUGH, M.D., Chicago

The small intestine constitutes 75% of the alimentary tract and averages 22 ft. in length. For the area exposed, the small intestine enjoys as great an immunity from new growth as any part of the body. In contrast, the stomach and the colon, which precede and follow the small bowel, are the sites of more than 40% of all malignant growths. No satisfactory explanation has been found for the low incidence of new growth in this segment of the gastrointestinal tract. The most widely accepted hypothesis is that of the alkalinity of the bowel contents and the minimum of stasis and kinking in this segment of the bowel.[1]

The preoperative recognition of small bowel tumors parallels the development of roentgenology. During the past few years these lesions have aroused an increasing interest and are being recognized with greater frequency.[2-7]

In 1951 [8] we reported a series of 16 small bowel tumors, of which 6 were carcinomas, 5 were sarcomas, 3 were carcinoid tumors, and 2 were benign. Since that time 12 additional small bowel tumors have been encountered at St. Luke's Hospital, Chicago, through June, 1956.

This study is based on the 28 tumors of the small bowel, 22 of which were malignant and 6 of which were benign. Attention will be directed to the symptoms, physical findings, x-ray findings, and the pertinent laboratory data. We hope to create a greater awareness of small bowel tumors, so that more early diagnoses may be reached and satisfactory surgical treatment instituted.

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 29, 1956.

From the Departments of Surgery, St. Luke's Hospital, Northwestern University Medical School, and University of Illinois College of Medicine.

Incidence

The incidence of small bowel tumors is greater in autopsy material than in surgical specimens. Many tumors are found incidentally at autopsy. Buckstein,[9] in 22,810 autopsies at Bellevue Hospital, New York, found 69 tumors of the small bowel, of which 35 were benign, 29 were malignant, and 5 were unclassified. C. W. Mayo [10] reported 108 malignant tumors of the small bowel between 1907 and 1939 at the Mayo Clinic. During the same years Weber and Kirklin [11] reported 41 benign lesions of the small bowel from the same institution. Ficara and Marshall [12] encountered 29 carcinomas of the small bowel at the Lahey Clinic in a 30-year period. Fraser,[13] of Glasgow, reported 13 malignant tumors of the small bowel in 22,975 operations on the gastrointestinal tract and 2674 autopsies in a decade. Shallow, Eger, and Carty [14] reviewed the literature between the years 1858 and 1939. They collected 137,174 general autopsies, among which were 5034 carcinomas of the colon, an incidence of 3.66%, and 134 carcinomas of the small bowel, an incidence of 0.098%. This is a ratio of approximately 1 carcinoma of the small bowel to 36 carcinomas of the colon. Cameron,[15] Raiford,[16] and Morison [17] reported similar findings.

Symptoms

There are no early symptoms that are characteristic of all small bowel tumors

TABLE 1.—*Symptoms*

	Patients, No.	Per Cent
Weight loss	23	82.1
Intestinal obstruction	21	75.0
Nausea and vomiting	18	64.2
Pain	16	57.1
Diarrhea	7	25.0

(Table 1). Peptic ulcer, gallbladder disease, and chronic pancreatitis may mimic the symptoms of a small bowel tumor in the early stages of development.[18] A marked loss of weight was the most significant complaint, occurring in 23 of the 28 patients, or 82.1%. In 18 of the 22 patients having malignant lesions, there was a loss of from 8 to 40 lb. in from four to eight months.

Recurring episodes of partial intestinal obstruction were present in 21 of the 28 patients, or 75%. These episodes manifested themselves by pain and abdominal cramps. Loud borborygmi were heard frequently at the time of the cramps. Relief was usually attained by vomiting. Jejunal carcinomas produce obstructive signs in more than 70% of patients according to Pridgen et al.[19] They found evidence of partial obstruction in 79% of patients having carcinoma of the ileum, the duration varying from one month to four years, with the average duration being six and one-third months.

Pain was present in 16 of the 28 patients, or 57.1%. The pain had its onset in most patients some 30 to 60 minutes after meals. The pain was of varying degrees of intensity and was usually located in the vicinity of the umbilicus. Pain occasionally radiates to the back. Such pain was attributed by Horsley[20] to involvement of the root of the mesentery. Partial or complete obstruction produces pain by encroachment on the bowel lumen or from intussusception. Acute obstruction usually occurs in polypoid tumors, benign or malignant. Intussusception in the adult is frequently precipitated by a tumor in the small bowel.[21]

Nausea and vomiting usually follow the onset of cramps and pain.[22-24] Nausea and vomiting were present in 18 of the 28 patients, or 64.2%. The vomiting associated with jejunal tumors occurs shortly after eating, consists of all the food eaten, and results in relief of the pain. In contrast, in tumors of the ileum the vomiting is delayed and the pain may not be relieved by the vomiting.

Episodes of diarrhea were present in only 7 of the 28 patients, or 25%. The interval between attacks varied between one and three months. The diarrhea frequently follows an attack of partial obstruction.

TABLE 2.—*Physical Findings*

	Patients, No.	Per Cent
Anemia—severe	18	64.2
Abdominal distention	16	57.1
Hyperperistalsis	16	57.1
Palpable mass	10	42.8

Physical Findings

Anemia of severe degree was present in 18 of the patients, or 64.2% (Table 2). Seventeen of the eighteen patients with severe anemia had carcinoma or sarcoma. None of the patients having carcinoid tumors had marked anemia. One patient with a benign tumor had a marked anemia. Mayo and Nettrour[25] noted that 5 of their series of 31 patients with carcinoma of the small bowel had been treated for anemia without success.

Distention of the abdomen, suggesting a partial intestinal obstruction, was present in 16 patients, or 57.1%. Associated with the distention was evidence of hyperperistaltic activity.

A palpable mass was present in 10 patients, or 42.8%. Those jejunal tumors which were palpable were in the left upper quadrant of the abdomen, and the palpable ileol tumors were in the low midabdomen or right lower quadrant.

X-Ray Findings

X-ray examination is the most decisive procedure which can be utilized in the actual diagnosis of a tumor of the small bowel. The examination must be individualized, never standardized. Since symptoms of intestinal obstruction were present in 75% of the patients, the value of preliminary scout films before the intake of barium is self-evident. Jenkinson and associates[26] have recently emphasized this point. An unusual amount of gas in the small bowel is an abnormal finding.

A dilatation proximal to an area of constriction is the commonest finding with the

TABLE 3.—*Carcinoma and Carcinoid Tumors of the Jejunum and Ileum*

Type of Tumor	Patients, No.
Adenocarcinoma of jejunum	4
Papillary adenocarcinoma of jejunum	2
Adenocarcinoma of ileum	4
Mucoid carcinoma of ileum	1
Carcinoid tumors of ileum	4
Total	15

use of barium.[27] Retention of barium in the small bowel for a period of more than eight hours is suggestive of a lesion. Segmentation of barium in the small bowel suggests disturbed motility and merits further investigation.[28]

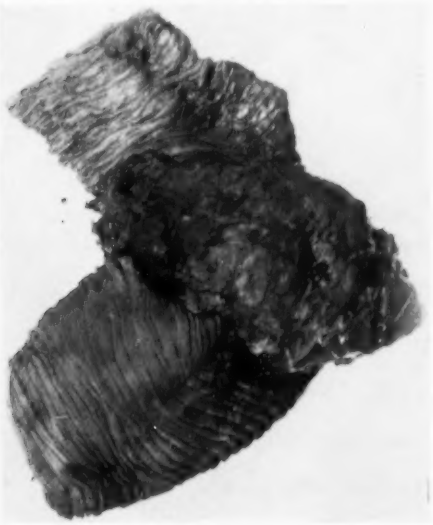
The small bowel enema, popularized by Schatzki,[29] was not used in this series of patients. The technique of choice at St. Luke's Hospital, used by Jenkinson, is the progressive meal or fractional study. Fluoroscopy and films are made at 20-minute intervals until the barium has left the small bowel.

Pathology

Carcinoma

Carcinoma (Table 3) was present in 11 of the 28 patients, or 39.2%. Six of the tumors were in the jejunum, and five were in the ileum. Metastatic spread was present in all the tumors.

Fig. 1.—Papillary carcinoma of the jejunum. The tumor produced severe bleeding which led to collapse of the patient while working.



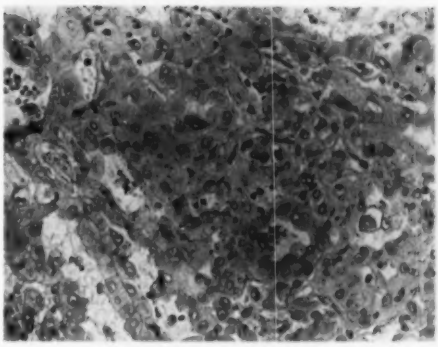


Fig. 2.—Photomicrograph illustrating the mosaics of carcinoma cells in the papillary tumor of the jejunum.

CASE 1.—*Papillary Carcinoma of the Jejunum*

A 47-year-old white man entered St. Luke's Hospital on Oct. 10, 1950. He had collapsed while working in a steel mill and was sent to the hospital in an ambulance. He gave a history of abdominal cramps and pain, nausea, and vomiting of two or three weeks' duration. There had been a 20 lb. loss of weight in the preceding six weeks. Physical examination revealed a moderate weight loss and abdominal distention.

Laboratory studies showed 8 gm. of hemoglobin per 100 cc. Red blood cells numbered 2,400,000 per cubic millimeter. The sedimentation rate was 130 mm. in an hour (Westergren). Stool examination revealed 4+ occult blood. Repeated blood transfusions failed to maintain the blood level. Surgery was carried out promptly. A papillary carcinoma of the jejunum was found (Figs. 1 and 2). Metastases were present. Extensive resection was done. The patient died six months later, and extensive metastases were found at autopsy.

Sarcoma

Seven tumors (Table 4), or 25%, were sarcomas. All the tumors were in the ileum. Five of the tumors were extraluminal and nonobstructive. A characteristic finding was

TABLE 4.—*Sarcomas of the Jejunum and Ileum*

Type of Tumor	Patients, No.
Lymphosarcoma of ileum	2
Spindle-cell sarcoma of ileum	1
Myosarcoma of ileum	2
Myeloblastic sarcoma of ileum	1
Reticulum-cell sarcoma of ileum	1
Total	7

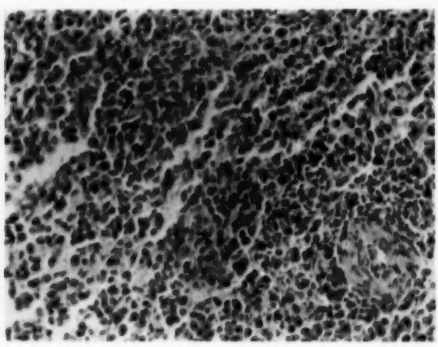
Fig. 3.—Reticulum-cell lymphosarcoma of the ileum which produced bleeding, intermittent obstruction, and diarrhea. The lesion was not demonstrated by x-ray.

extensive adhesions of an inflammatory nature to the surrounding structures. Evidence of metastatic spread was found in four of the seven cases.

CASE 2.—*Reticulum-Cell Lymphosarcoma of the Ileum*

A 40-year-old white woman entered St. Luke's Hospital on Jan. 10, 1955. She complained of periumbilical pain, intermittent diarrhea with blood in the stools, and a 12 lb. loss of weight during the preceding six weeks. Complete gastrointestinal x-ray studies were negative. Exploration was carried out despite the negative report. A reticulum-cell lymphosarcoma of the lower ileum was found and resected (Figs. 3 and 4). No regional metastases were evident grossly or in the specimen. The patient is living and well, with no evidence of recurrence.

Fig. 4.—Photomicrograph illustrating the reticulum-cell lymphosarcoma tissues.



Carcinoid Tumors of the Ileum

Four tumors (Table 3), or 14.2%, were carcinoid tumors, and all were located in the ileum. Metastatic spread was present in all patients. The carcinoid tumors were multiple in each instance.

CASE 3.—*Carcinoid Tumor of the Ileum with Metastases*

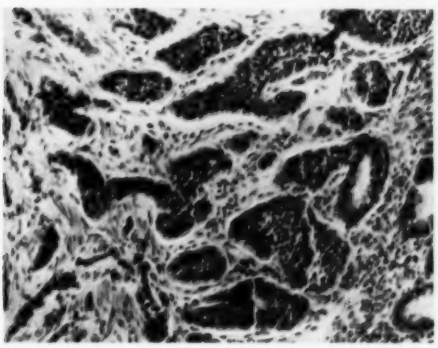
A 62-year-old white man entered St. Luke's Hospital in March, 1956. He complained of periodic attacks of abdominal cramps with periumbilical pain of three years' duration. Repeated gastrointestinal x-ray studies elsewhere were reported as negative. The patient had been on a bland, low-residue diet during the three years with no weight loss. A ruptured appendix had been removed through a right rectus incision at the age of 21. The only abnormal laboratory

Fig. 5.—Dilated loop of the lower ileum with area of constriction and partial obstruction. Barium has passed the constriction. The film was made five hours after barium was taken by mouth.

Fig. 6.—Carcinoid tumor producing partial obstruction of the lower ileum. Five carcinoid tumors were in this segment of bowel. Metastatic spread to the mesentery was evident grossly.

finding was an elevation of the alkaline phosphatase to 12.4 Bodansky units. Small bowel x-ray studies revealed a partial obstruction with kinking in the ileum (Fig. 5). At operation many small nodules were palpable in the bowel, and extensive resection was carried out (Figs. 6 and 7). Gross evidence of metastases was found in the mesentery (Fig. 8). The patient has remained well to date.

Fig. 7.—Photomicrograph illustrating the carcinoid tissues in one of the nodules in the lining of the small bowel.



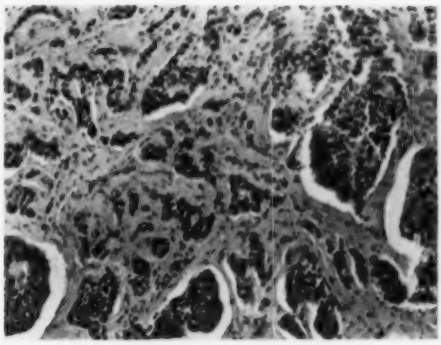


Fig. 8.—Photomicrograph illustrating the carcinoid tissues metastatic in the mesentery.

Benign Tumors

Six tumors (Table 5), or 21.4%, were benign. Three tumors were in the jejunum, and three tumors were in the ileum.

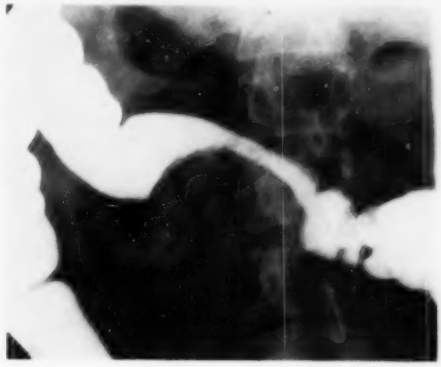
CASE 4.—*Fibroleiomyoma of the Jejunum*

A white woman, 54 years of age, entered St. Luke's Hospital in June, 1956. Her only complaint was the presence of a movable mass in the upper abdomen. X-ray studies revealed an extraluminal tumor overlying the transverse colon (Fig. 9). Postevacuation x-ray films re-

TABLE 5.—*Benign Tumors of the Jejunum and Ileum*

Type of Tumor	Patients, No.
Fibroleiomyoma of jejunum	1
Fibromyoma of jejunum	1
Papillary nevus of jejunum	1
Submucous fibromyoma of ileum	1
Fibroma of ileum	1
Leiomyoma of ileum	1
Total	6

Fig. 9.—Barium enema demonstrating an extraluminal shadow overlying the transverse colon.



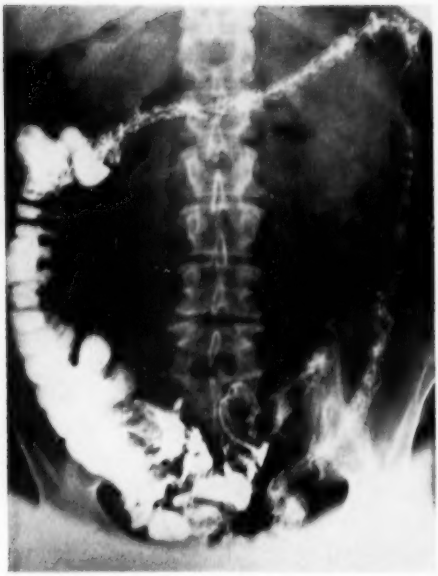


Fig. 10.—Postevacuation film revealing a normal mucosal pattern of the transverse colon. A shadow can be noted beneath the transverse colon and to the right of the midline.

Fig. 11.—Fibroleiomyoma of the jejunum. The tumor was freely movable. No gastrointestinal symptoms were produced by this growth.

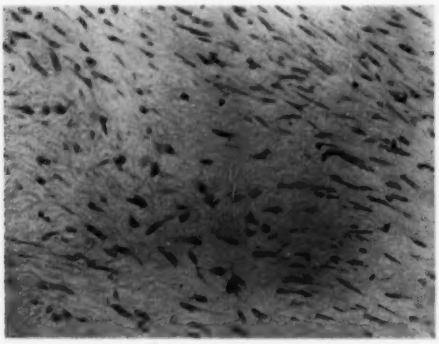


Fig. 12.—Photomicrograph illustrating the structure of the tumor tissues. They had a larger content of the fibrous elements and a few bands of elongated spindle cells considered to be smooth muscle.

vealed a normal mucosal pattern, with a shift in position of the tumor mass (Fig. 10). Small bowel x-ray studies were negative. At operation, a large fibroleiomyoma of the jejunum was identified and resected (Figs. 11 and 12). Recovery was uneventful.

CASE 5.—*Papillary Nevus of the Jejunum.*

A white man, aged 39, entered St. Luke's Hospital in February, 1955. He complained of having had periumbilical cramps and pain at intervals of two to three weeks for six years. The pain and cramps increased in intensity over a two- to three-

Fig. 13.—Dilated jejunum with an area of constriction and partial obstruction. The lesion causing the constriction was a papillary nevus.

Fig. 14.—Papillary nevus of the jejunum which produced periumbilical pain and intermittent diarrhea.

hour period and were always relieved by an enema. There had been no weight loss. All laboratory studies were within normal limits. Small bowel x-ray studies revealed dilatation of the upper jejunum with an area of constriction of the lumen below a dilated segment of bowel (Fig. 13). At operation 40 cm. of jejunum, containing a constricting papillary nevus, was resected (Figs. 14 and 15). The patient is well at the present time.

Operability and Prognosis

Of the 11 patients having carcinoma, 9 patients were explored, and eight lesions were resected. Two tumors were found at autopsy. Five of the eight patients having resection died within a few months of recurrence. Three patients in whom resection was carried out are well, with no evidence of recurrence after one, two, and two and one-half years, respectively. There were no deaths from the operative procedure.

In the seven patients having sarcoma, six resections were carried out. One tumor was discovered at autopsy. Two patients are living two years and eight years, respectively. Four patients died within a few months, of recurrence. There were no operative deaths.

Of the four patients having carcinoid tumors, resection was done in all and all are living, after 9 months, 15 months, 3 years, and 5 years, respectively.

Resection was done in six patients having benign lesions. All are living and well.

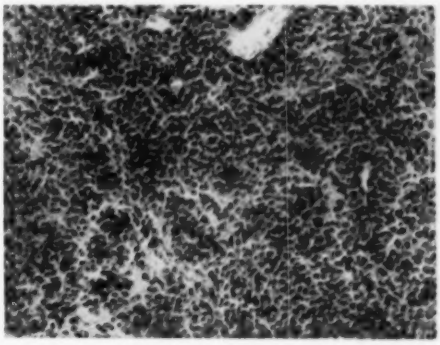
Comment

In modern medicine we rely on the x-ray department to demonstrate pathology which is present in the gastrointestinal tract. Surgeons prefer graphic evidence of disease from the x-ray before carrying out abdominal surgery. The small bowel, however, remains a difficult segment for accurate examination by x-ray. Much more study is required before small bowel examination approaches the efficiency which has been attained in the diagnosis of lesions of the stomach and colon. We must rely heavily upon the history and clinical findings. When doubt exists, we believe that abdominal exploration is indicated when a small bowel tumor is suspected.

The symptoms of small bowel tumors are those related to obstruction of varying degree. The symptoms include weight loss, nausea and vomiting, pain which is usually periumbilical, abdominal distention, hyperperistalsis, and anemia.[30]

Twenty-two of the twenty-eight tumors were malignant—eleven carcinomas, seven

Fig. 15.—Photomicrograph illustrating the papillary structures of the nevus tissues.



sarcomas, and four carcinoid tumors. We think that carcinoid tumors are malignant, and the incidence of metastases of these tumors in various areas of the gastrointestinal tract parallels the stage in time at which the tumor is detected.[31] Sixteen malignant tumors were located in the ileum, and six, in the jejunum. Metastatic spread was evident in 18 of the 22 patients having malignant lesions. Liver metastases may be the only involvement, since the cells may spread by the portal venous tributaries, bypassing the regional lymph nodes. Such a spread is particularly common in carcinoid tumors.

From the evidence obtained in this study, it would appear that we must develop an awareness of small bowel tumors. The symptoms, which frequently simulate gallbladder disease, peptic ulcer, or chronic pancreatitis, may be minimized. Our hope for better results rests with more early diagnoses and prompt surgery.

Summary and Conclusions

Twenty-eight small bowel tumors of the jejunum and ileum are analyzed. Twenty-two tumors were malignant; eleven were carcinomas; seven were sarcomas, and four were carcinoid tumors. Six tumors were benign.

One carcinoma of the small bowel exists to approximately thirty-six carcinomas of the colon.

The symptoms produced by small bowel tumors are those of obstruction of varying degree.

X-ray examination is helpful in establishing a diagnosis. The history and physical examination may be more important than the x-ray in a decision for or against surgery.

The results of surgery are poor for malignant tumors and excellent for benign tumors.

Better results will be obtained when an awareness of such tumors is created in the diagnostic armamentarium of physicians.

122 S. Michigan Ave. (3) (Dr. Strohl).

DISCUSSION

Dr. B. C. Kilbourne, Chicago: Drs. Strohl and Diffenbaugh are to be commended for their excellent study and presentation of the small bowel tumor experience at St. Luke's Hospital. The finding of 14 new cases in the past 5 years, as compared with 16 cases in the previous 20 years, reflects an increased interest in such lesions, for which we at St. Luke's are indebted to the authors.

To further develop one aspect of this subject, I should like to show two slides and to comment on intussusception as a manifestation of small bowel tumors.

[Slide] This is an ileoileal intussusception in a 30-year-old man. He entered with a partial obstruction of the small bowel, which became complete during the preoperative work-up. At operation, prior to reduction of the invagination, we thought that we were dealing with a tumor or a Meckel diverticulum.

[Slide] This is the resected specimen, showing sufficient edema and inflammation to obscure a small tumor. The opened bowel discloses this pedunculated submucous fibroma.

Tumors may cause up to 70% of intussusceptions in adults. Many ileoileal or recurrent intussusceptions in children may be on this basis. More than half of the reported cases with multiple small intestinal polyps of Jeghers' syndrome have experienced intussusception. Multiple polyps and multiple neurofibromata present the likelihood of serial and recurrent intussusception.

When the abdomen is open for any cause, careful examination of the small bowel may disclose an asymptomatic tumor. Multiple tumors must be considered. In adults resection of intussuscepted bowel may disclose a tumor which is not palpable and which would be overlooked with a smaller procedure.

Dr. Robert A. Wise, Portland, Ore.: Intestinal obstruction is a frequent finding in small intestinal tumors, and the symptoms of small bowel obstruction are often predominant. I should like to emphasize the incidence of obstruction in tumors of the small bowel by showing three slides.

[Slide] This is a carcinoma of the jejunum with metastasis to the regional mesenteric nodes. You will note the marked dilatation of the jejunum proximal to the tumor and the small caliber of the bowel distal. The presenting signs in this patient were those of high small bowel obstruction.

[Slide] This illustrates a method used in the diagnosis of small bowel tumors first employed, I believe, by our president. A long tube is allowed to enter the upper jejunum, and thin barium is introduced. You will note the marked filling de-

fect in the upper jejunum outlined by the barium.

[Slide] This was a leiomyosarcoma of the upper jejunum causing intussusception and high small bowel obstruction.

DR. W. G. DIFFENBAUGH, Chicago: Two additional patients with small bowel tumors have been seen at St. Luke's Hospital since the completion of this paper. Both had carcinomas of the jejunum. One carcinoma was in a 48-year-old man and was inoperable. The other is worthy of mention, as it emphasizes the theme of our presentation. The patient, a 42-year-old woman, complained of lower abdominal pain and left upper quadrant pain of five months' duration. This pain was constant and was aggravated by walking. Periods of diarrhea were present. The patient had been treated for marked anemia by repeated transfusions and by hematinics. During the five-month period three complete gastrointestinal x-ray series had been done at various places, with no abnormal findings. In view of the persistent symptoms and the marked anemia, the patient's abdomen was explored by Dr. John Pribble. A large annular carcinoma of the jejunum was found just distal to the ligament of Treitz. Metastatic nodes were present. The tumor and nodes were resected.

In this entire series of cases, x-rays were of help in the diagnosis in less than 50% of the patients. Exploration must be done if symptoms and findings persist, despite negative x-ray reports.

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Perforated Appendicitis

Three Hundred Ninety-One Cases Without Mortality

R. MORTON BOLMAN II, M.D.; ROBERT P. LLOYD, M.D., and ROBERT R. JOHNSON, M.D., Fort Wayne, Ind.

It is generally agreed that the ultimate elimination of appendicitis as a cause of mortality lies in early diagnosis plus prompt and adequate surgery. In spite of universal acceptance of this dictum, just short of 5000 persons died of perforated appendicitis in the United States last year. This study deals with a series of 391 cases of perforated appendicitis without mortality, 305 being operated upon by us and 86 by other surgeons using our exact technique of treatment. During the same period covered by this study, 104 cases of perforated appendicitis were operated on in another hospital in our community with eight deaths, a mortality of 8%. This presentation in no way deals with the diagnosis of acute appendicitis per se but rather with the management of perforated appendicitis and the myriad of problems involved in the successful prosecution of its treatment.

In the year 1930, a total of 18,000 deaths from appendicitis were recorded in the United States.[1] In the year 1955 [2] a few less than 5000 deaths from this entity were recorded. When one considers the substantial increase in population in the United States in the 25 years between these reports, the decrease in deaths per unit of population would be on the order of one to six. In other words, the mortality has been decreased sixfold.

Cantrell and Stafford,[3] in a recent publication, have said that "the residual mortality from appendicitis is determined by the incidence of perforation; unperforated appendicitis carries virtually no mortality." It would seem, then, that the surgical management of perforated appendicitis must account for a sizable proportion of any further improvement in the mortality statistics.

The improvement of surgery these past years has opened many new vistas to us all. It is the firm belief that the rigid application of all these improvements to the treatment of perforated appendicitis will all but eradicate its residual mortality that leads to this presentation. Dr. Ochsner [4] has said that perhaps we have become complacent about appendicitis in our interest in more complicated surgery and urges that the menace of appendicitis be reemphasized to public and doctors alike.

Conroy,[5] reviewing 237 cases of appendicitis for 1947 and 1948, found 31 of these perforated. Three of these patients died, for a mortality of 10%. In 1949 McGraw [6] reviewed appendectomies over a 10-year period at his institution. In the last five years of the study there was no mortality. Roughly 100 of these operations were for perforated appendicitis. This is one of the earliest reports of a sizable series of operations for perforation without mortality. McGraw attributes the lack of mortality to absolutely rigid adherence to a fixed pattern of care and rates gastric suction high on the list of advancements.

Since 1902, when Ochsner [7] first recommended the conservative treatment of spreading appendiceal peritonitis, surgeons have been divided into those who recommend prompt surgery, those who delay or abstain

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 29, 1956.

Specialists certified by the American Board of Surgery (Drs. Bolman, Lloyd, and Johnson); Fellow, American College of Surgeons (Drs. Bolman and Lloyd).

from operation in the presence of spreading peritonitis, and those between these groups whom Boyce [8] describes as using conservatism "on the threshold of the operating room." Ransom [9] has written an excellent review of the latter phase of the problem. Bancroft [10] restricts the conservative management to the very active type of disease with peritonitis in a patient who would not tolerate surgery well. He stresses the fact that when conservatism is chosen it must be applied with the same rigid attention to detail that characterizes the surgical approach.

A great division of opinion has also existed concerning the advisability of attempting to drain the peritoneal cavity. Lahey [11] has said, "When in doubt, drain." Meyer [12] and his associates feel that only the wound should be drained, even when contamination is gross. Bancroft [10] definitely states the limited usefulness of drainage.

The management of the appendiceal stump has also been a controversial point, with many excellent surgeons favoring simple ligation. Horsley [13] and Seelig [14] have been among these. Willis [15] favored ligation and inversion of the ligated stump. Ochsner [16] and Lilly favored inversion of the unligated stump and suggested an effective figure-of-eight suture that served as a purse string and controlled the blood supply. John Clark,[17] of Philadelphia, preferred to excise a small segment of cecum and close it aseptically over a clamp. Jordan [18] and Hollenbeck, in 1953, reported 107 consecutive, unselected cases of perforated appendicitis without mortality, a surgical landmark.

A large majority of recent authors favor the McBurney type incision, but even here there is difference of opinion. Lahey [11] favors a long right rectus incision, while Bower [19] favors a transverse incision.

Some surgeons use the Levin tube and gastric suction routinely in the perforated appendix and advise against efforts at intestinal stimulation. Among these are Murphy [20] and Weigel.[21] Noble [22] feels that paralytic ileus does not occur in appendiceal peritonitis and advocates the vigorous use of posterior pituitary injection (Pituitrin). Another group uses the tube and suction only after distention begins.

There is practical agreement on the general vigorous use of antibiotics, and these drugs have been variously credited with reducing the mortality by at least half. McLanahan [23] reports 111 cases of perforated appendicitis in children, with only one death. Many of these antedate the antibiotic era, an indication that management other than antiobiotics greatly influences mortality. This then is a brief review of a surgical entity which used to promise a mortality as high as 50%. Now, through the efforts of our colleagues and predecessors, its mortality has been reduced to the point that several sizable series have been reported which indeed show no mortality. May I present our series?

This series of cases, 391 in number, has been collected consecutively and without selection between Oct. 1, 1945, and Oct. 1, 1956. Three hundred five of these cases have been managed directly by us, and eighty-six by surgeons under our direct supervision. The size of the series is accounted for by the fact that in our community many men do their own "ordinary" appendectomies but refer this type of case. In all cases, we have taken over completely before, during, and after surgery, to the end that our system of treatment would be applied completely or not at all. We have talked about our system of treatment to our own hospital staff, to local and adjoining County Medical Societies, and to State Societies. We have made colored movies of the technique, which we

TABLE 1.—*Age Incidence Among Three Hundred Ninety-One Patients with Perforated Appendicitis*

Age Range, Yr.	Patients, No.
0–10	41
11–20	110
21–30	96
31–40	49
41–50	38
51–60	28
61–70	18
71–80	8
81–90	3

The youngest patient was 14 months; the oldest was 89 years; 217 were males; 174 were females.

have shown to any medical people who expressed interest. Our constant point has been that any new reduction in the mortality from perforated appendicitis must come from handling this entity with the same precision and care at every stage as are usually reserved for a gastric resection or a pneumonectomy. We feel certain that this series of cases results more from an attitude than from any unusual or occult ability. The attitude only means bringing all the armamentarium at our disposal to bear on a perforated appendix and treating this disease entity with the same respect that we have for a vascular or an upper abdominal problem.

Our patients ranged in age from 14 months to 89 years, and their relative age distribution can be seen in Table 1.

Table 2 shows the incidence of three types of incisions and the number of hernias that followed each. We use the McBurney incision exclusively. The 33 patients who had other incisions had them because of diagnostic doubt. We feel that, the more positive one is of the diagnosis, the further lateral the incision should be. Whenever possible, the incision should center itself vertically over the point of maximum tenderness when this can be elicited.

TABLE 2.—*Types of Incisions*

Type of Incision	Postoperative Hernias	Per Cent
McBurney—358/91.5%	8	2.23—four drains
Right rectus—28/7.1%	7	25—two drains
Lower midline—5/1.4%	1	20—one drain

Two wound dehiscences occurred; both were in right rectus incisions.

The type and relative number of complications are shown in Table 3. Several require explanation. The two septic pulmonary emboli required closed and then open drainage of the chest, and one required a localized thoracoplasty to collapse a small residual empyema cavity. Both patients with hemorrhage were treated conservatively with blood replacement. Although they both recovered, they represent our two longest hospital stays, and one wonders whether early secondary intervention might not have been preferable. The three dehiscences of the stump occurred prior to the use of the free omental graft. The fecal fistulae that followed them closed spontaneously in two instances but required rehabilitation and late right hemicolectomy in the remaining one. The low incidence of thrombophlebitis and embolism can be ascribed only to energetic early ambulation and the prevention of abdominal distention. This fixed attitude toward early ambulation worked out to be a real hardship to one of us who is included in this series of cases.

TABLE 3.—*Complications*

	Type	No.	Per Cent
1	Wound dehiscence	2	0.51
2	Wound abscess	11	3.0
3	Pelvic abscess	7	2.0
4	Pulmonary emboius	3–2 septic	0.75
5	Subphrenic abscess	3	0.75
6	Left gutter abscess	2	0.51
7	Hemorrhage	2	0.51
8	Obstruction	3	0.75
9	Stump dehiscence	3	0.75
10	Fecal fistula	3–2 closed	0.75
11	Hematoma	2	0.51
12	Thrombophlebitis	2	0.51
13	Postoperative hernia	16	4.0
14	Coronary occlusion	2	0.51

Table 4 presents the longest and the shortest hospitalization as well as the average. The addendum shows adjustments by removing the more serious complications.

Table 5 shows the associated diseases presented by these patients. The recognition that the associated disease is present, and its adequate management at every step in the patient's care, will reduce the additional mortality incident to its presence to an absolute minimum.

With use of the classification of Schullinger,[24] our cases may be divided into 43, or 11.0%, with localized peritonitis; 118, or 30%, with abscess; 141, or 36%, with acute diffuse peritonitis, and 89, or

TABLE 4.—*Period of Hospitalization*

Shortest	Longest	Average
5 days	62 days	16.4 days

- 372 of these patients spent an average of 12.9 days in the hospital.
- 210 spent an average of 8.4 days in the hospital.
- 167, a little less than half, spent a week or less in the hospital.

TABLE 5.—*Associated Diseases*

	Disease	No.	Per Cent
1	Diabetes	11	3.0
2	Previous coronary occlusion —2 yr.	8	2.23
3	Hypertension	39	10.0
4	Cancer (3 colon)	4	1.02
5	Pertussis	2	0.51
6	Cardiac (exclusive of coronary occlusion)	6	1.6
7	Postoperative gastrectomy	1	0.25
8	Kidney	2 (1 was on artificial kidney 5 days)	0.51
9	Peptic ulcer	4	1.02
10	Acute polio	1	0.25
11	Pregnancy	6	1.6

23.0%, with acute fibrinopurulent peritonitis. We have not followed Ladd's [25] theory that if one progresses far enough to determine the type he has done an improper operation.

The Murphys [29] have clearly enunciated our attitude. They recommend an offensive rather than a defense: a complete assessment of the case and a definite plan of treatment decided at the outset, as well as a rigid attempt to prevent all those small complications which so frequently pave the way for those of consequence.

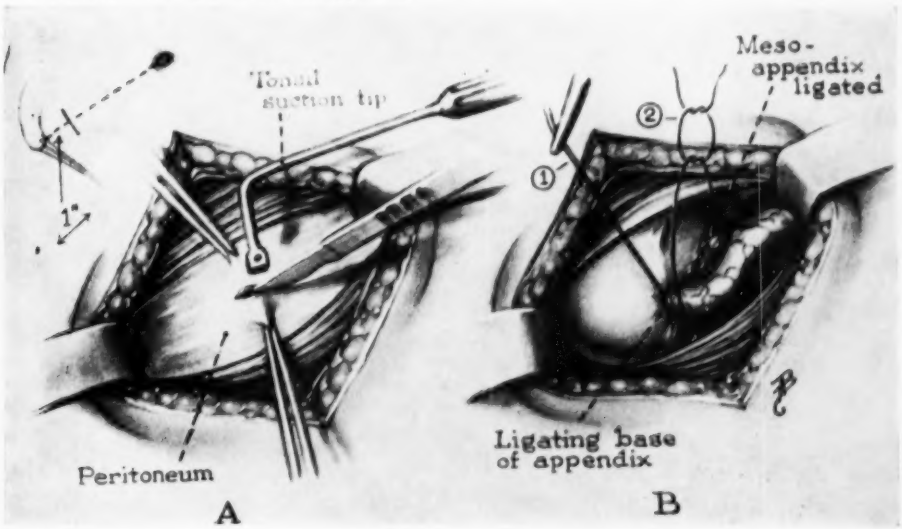
Intelligent preoperative preparation and a considered decision regarding the correct time for intervention form the basis of success in this as in all surgery on sick people. An exact history will bring out the duration of the illness; the presence of preexisting disease; the presence of drug sensitivity; the nature of previous surgical experience; the necessity for continuation of previous medication, and the extent to which the ancillary diagnostic services need to be used for a correct evaluation of the whole patient. In general, the sicker the patient, the firmer the diagnostic base line must be. In a critically ill patient in whom dehydration, electrolyte imbalance, protein deficiency, and buffer depletion are extreme, a measure of the vital blood elements at the outset will allow for intelligent replacement. A hematocrit reading, along with the blood chemistry study, allows an estimate of how much of the imbalance can be accounted for on the basis of concentration. Rather than hurry the critically ill patient, we have felt that he is the one who needs perhaps the longest period of preparation. In general, a patient who will not tolerate preparation is in no way apt to tolerate anesthesia and surgery. Having availed one's self of the laboratory and x-ray departments, there is no substitute for clinical acumen in the estimate of surgical readiness. The skin turgor, the character of the tongue, the facies, the character of the pulse, the eyes, the ease of respiration, skin color, skin texture, and the sound of the chest, all these, together with the laboratory findings, will dictate the time for apt intervention. All 391 patients in our series have been operated on. The appendix has been removed in all but two patients. The minimum time between admission and surgery has been 2 hours; the maximum has been 21 hours; the average has been 6 hours and 20 minutes. When preparation is necessary, a Levin tube and suction are installed immediately, and the patient keeps this through surgery and afterward until normal peristalsis is established. During the period of preparation penicillin, 600,000 units, and streptomycin, 0.5 gm., are given intramuscularly every eight hours. In the critical patient, if his urinary output is near adequate during his first intravenous infusion, 2.5 gm. of sulfadiazine sodium is given during the second one. It is our impression that this drug still has its place in the treatment of spreading peritonitis. This dose is for a 150-lb. adult and is adjusted for children and elderly adults. If urinary output continues to be satisfactory after surgery, the sulfadiazine is repeated once in the first 24 hours postoperatively. Only these two doses are used. The penicillin and streptomycin are continued postoperatively, to be supplemented when necessary with whatever antibiotic is recommended by the sensitivity tests run routinely on the exudate obtained at surgery. The urinary output is followed by the installation of an indwelling catheter. In most instiutions, including ours, there is no other way to obtain an accurate output record. During the preoperative period any associated dis-

ease must be evaluated, its importance estimated, and a pointed attempt toward control instituted. In a group or a university center, this is a good spot for the surgical internist. In an outlying community, such as ours, the more nearly the surgeon can double in this role, the happier the result is apt to be. The referring practitioner rarely welcomes an additional consultant. The barely compensated cardiac patient can be digitalized during this period. The diabetic can be stabilized. The coronary cripple can be given oxygen and vasodilators until decompression restores his circulation and gives him room to breathe. Proteins can be replaced with blood or serum albumin, as the situation dictates. Electrolytes and fluid can be replaced. We would stress again that this can be done intelligently in the critical patient only by original and repeated determination of blood chemistry. Fluid replacement in our institution is limited to a maximum rate of 80 drops per minute. The aged and the children are thus protected against circulatory overload.

When the proper time for surgery arrives, a consideration of anesthesia becomes necessary. Our community has a real and Germanic prejudice against spinal anesthesia, and so inhalation is our mode of choice. We are blessed with excellent anesthesia. We see these patients with the anesthesiologists, and we acquaint them with any pertinent facts necessary to choice of agents. Thiopental (Pentothal) sodium, cyclopropane, nitrous oxide, and ether through an endotracheal tube are the basic agents of our choice. Preoperative medication is light in these cases. So much for the preoperative period. Now, our technique of operation.

Figure 1 (inset) shows the location of the McBurney incision with its exaggerated lateral placement which we believe to be desirable in these cases. This incision can be enlarged in any direction, as pointed out by Bancroft.[10] Figure 1*A* shows the classical incision open down to the tented peritoneum. The suction is so placed as to receive the exudate prior to the opening of the peritoneum. Figure 1*B* demonstrates the double ligation of the uncrushed appendiceal base. When the proximal portion of the appendix is not involved in the inflammation, we never invert the stump. An accident with phenol early in this series has led us to treat the stump with mercocresols

Fig. 1.—(Inset) Far lateral McBurney incision. *A*, the peritoneum is opened with the suction tip ready to collect exudate as it appears. *B*, the uncrushed appendix is doubly ligated after segmental ligation of mesoappendix.



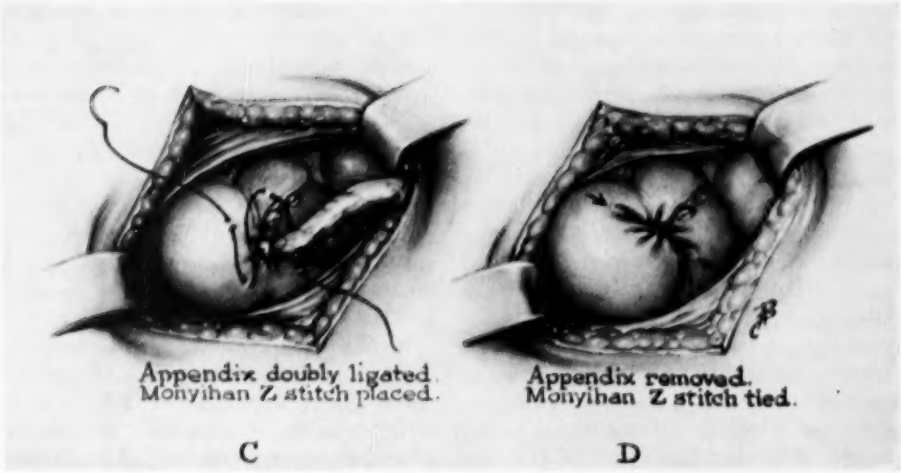


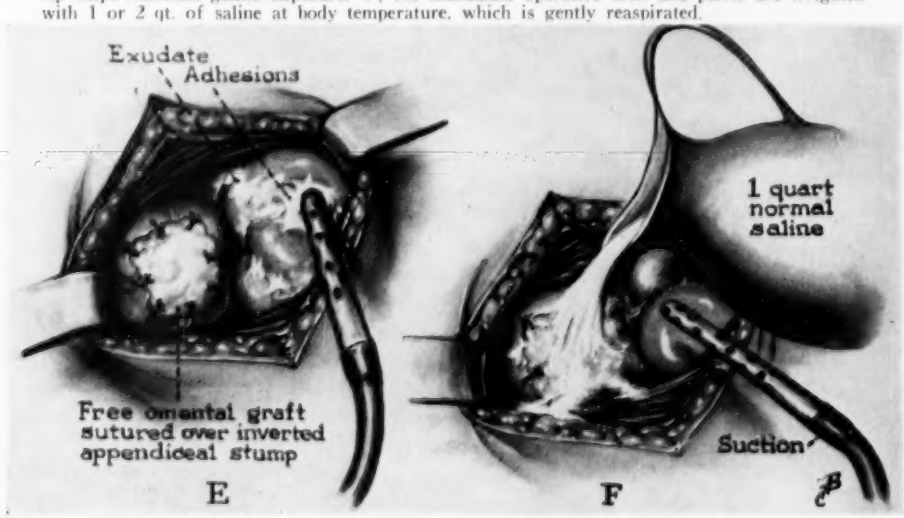
Fig. 2.—*C*, the Moynihan Z-stitch is placed prior to the removal of the appendix. *D*, the Moynihan Z-stitch is tied, leaving drainage ports in the cecal head.

(Mercresin) rather than any caustic agent.

When the basal portion of the appendix is inflamed and friable, a Moynihan[26] Z-stitch is used for inversion. This allows a drainage port at each end of the cecal closure. There have been no abscesses of the cecal head with this technique. Figure 2*C* shows the placement of the Moynihan stitch before removal of the appendix, and Figure 2*D* shows the inversion stitch tied and accentuates the drainage ports.

When the cecal head is friable or even necrotic, a double ligation, as in Figure 1*B*, is done, and, if possible, a Moynihan Z-stitch inverts the stump. In any case, a free omental graft is applied over the cecal head with the stump area at its center. This is held in place with fine interrupted ab-

Fig. 3.—*E*, a free omental graft is applied over a friable cecum and stump, the suction tip helps maintain gentle exposure. *F*, the immediate operative area and pelvis are irrigated with 1 or 2 qt. of saline at body temperature, which is gently reaspirated.

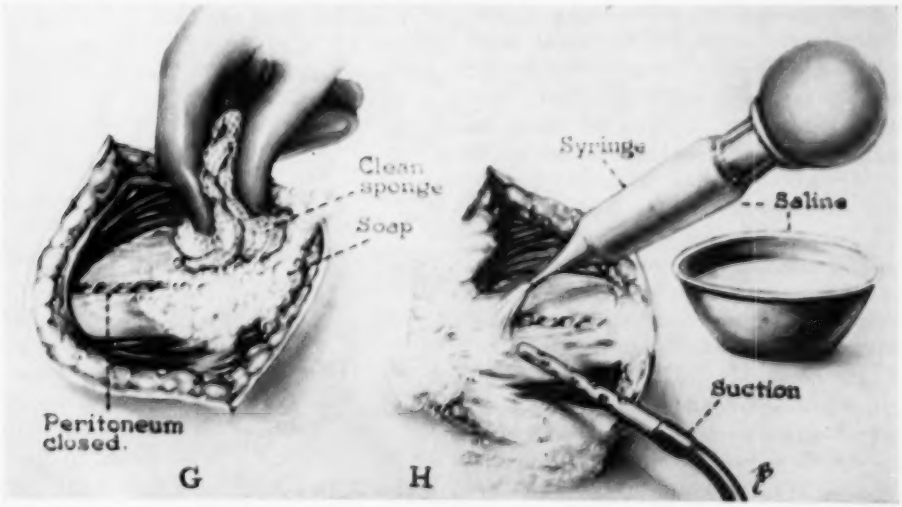


sorbable surgical sutures. Figure 3*E* shows such a graft in place and illustrates the constant use of the suction tip to minimize contamination and gently obtain adequate exposure. In all these cases a gentle exploring finger is introduced into the pelvis. Quite frequently a second, loculated collection of exudate is found and aspirated. We firmly believe that careful preparation and decompression preoperatively, plus the antibiotics, now allow this gentle exploration. Unquestionably it frequently enables primary recovery to occur. The loops of bowel in the immediate vicinity are inspected carefully and explored gently. If exudate is found, it is gently aspirated. At this point 1 to 2 qt. of saline at body temperature is poured slowly into the incision and allowed to gravitate to the pelvis, from which point aspiration is easy. This, we feel, reduces quantitative contamination to the point that the peritoneum, sometimes overwhelmed, can deal with it. This is illustrated in Figure 3*F*.

All of us at one time or another have placed sulfonamides and antibiotics in the abdomen. The sulfonamides form a real and insoluble foreign body, and we have not been able to get enough antibiotic to stay in the abdomen to be efficacious. The last 220 of these cases have had no medication placed in the abdomen. If there is a severe spreading peritonitis, the patient is given 1,000,000 units of aqueous penicillin and 1 gm. of aqueous streptomycin intramuscularly on the operating table to maintain a high blood antibiotic level immediately after the surgical insult. This also obviates any nursing delay in the recovery ward. The preoperative doses of the antibiotics are then continued into the postoperative period, until they are no longer needed or until sensitivity tests recommend a change.

Closure of the peritoneum is accomplished with fine continuous absorbable surgical suture. Dr. Raymond McNealy [27] at one time recommended scrubbing the abdominal wall (muscle, fascia, and subcutaneous tissure) with soap and water after tight closure of the peritoneum. We have followed this procedure religiously and can recommend it highly to reduce the incidence of abdominal wall abscess. This is shown in Figure 4*G*. Figure 4*H* shows the irrigation of the wound with 1 qt. of saline at body temperature with use of an asepto syringe. The suction tip is a clean one. The one used in

Fig. 4.—*G*, the peritoneum is closed tightly, and the layers of the abdominal wall are gently scrubbed with soap and sterile water. *H*, the soap is removed from the abdominal wall by profuse irrigation with saline and gentle aspiration.



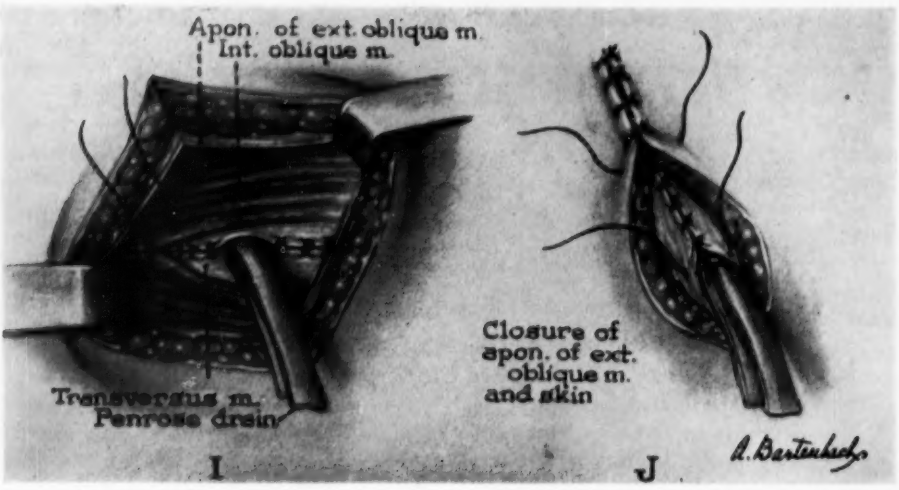


Fig. 5.—*I*, a Penrose drain has been placed to, but not through, the peritoneum, and the loose interrupted closure of the abdominal wall continues. *J*, the abdominal wall is all but closed with the drain in place, the drain remains only 48 hours.

the abdomen has been discarded, as have also the contaminated instruments and drapes. No intraabdominal drains have been used in the last 226 cases, and we find no indication for this type of drainage. We use Meyer's [12] idea of a Penrose-type drain merely to, but not through, the peritoneum. This is shown in Figure 5*I*. Figure 5*J* shows the completion of the loose closure with interrupted fine sutures. The drain is removed after 48 hours.

Those patients who came to surgery with a Levin tube in place keep it, and those without a tube receive one as soon as they are awake. Continuous suction is applied. There are no exceptions. Fowler's position is instituted immediately and maintained for 48 to 72 hours. Adequate fluids and electrolytes are administered, and chemistries are followed daily or every alternate day. Indwelling catheters are left in place. Adequate doses of morphine are given regularly to promote rest and to maintain the cooperation of the patient insofar as early ambulation and the Levin tube are concerned. In difficult patients dihydromorphinone (Dilaudid) hydrochloride has been very helpful. Except for the critical patient or one with extenuating circumstances, ambulation is begun 12 hours after surgery and continued four times daily. One of us was up in six hours. Our own nurses see to it that this is carried out, if the general duty nurses are too busy. We have no experience with the use of cortisone or corticotropin in this disease. The mere presence of a Levin tube in the nostril is no assurance of decompression. The tube must be adjusted and irrigated, and a systematic method of assuring this is necessary. Our patients are limited to 1 oz. of water per hour while the Levin tube is in place. It is left in place until the patient can pass flatus or have a bowel movement on the fourth or fifth day with a small enema.

Absolutely no intestinal stimulation is used by either posterior pituitary injection (Pituitrin) or neostigmine (Prostigmin) bromide. We feel that these drugs are potentially dangerous with a distended friable intestine. The first day the tube is out, the patient is still limited to 1 oz. of water hourly. If peristalsis continues to be normal at this time, fluids and food are rapidly increased. Antibiotics are continued until the temperature has been normal at least 36 hours, an average of 5 to 7 days.

In the critically ill patient, 1 pt. of blood is given empirically after surgery, and should he remain critical for several days, this is repeated, sometimes with only 250 cc., every day or two. Again, serum albumin is an excellent adjunct to protein maintenance. Large doses of vitamins are given in at least one infusion daily.

Oxygen is used as indicated, and, when in doubt, it is always used. We prefer nasal oxygen except in the case of a prolonged high fever. In this situation the cold oxygen tent is helpful.

If temperature, pulse, and other vital signs are not approaching normal in three days, the surgeon should begin a gentle daily search of the known trouble areas for complications. If another two days go by without signs of localization or improvement, it is not too early to observe the diaphragm by fluoroscopy for signs of abscess. By this inviolate practice complications are found and handled early in an already tired patient.

We believe then that a careful clinical evaluation of the whole patient, careful preparation of the patient including consideration for any associated disease, judicious timing of intervention, careful application of a standardized surgical technique varied only to fit the case at hand, good considered anesthesia, vigorous use of antibiotics, early and prolonged use of the Levin tube and suction to prevent, rather than treat, distention, early ambulation, generous use of proteins, vitamins, and blood, and an awareness of impending complications should reduce the mortality from perforated appendicitis to its irreducible minimum.

Summary

Three hundred ninety-one cases of perforated appendicitis which were operated on without mortality are presented.

The literature is reviewed.

Our mode of preparation, technique of surgery, and postoperative care are outlined.

The early and prolonged use of the indwelling stomach tube and suction is stressed. The aim, when possible, is to prevent, rather than to treat, distention.

It is believed that complete application and strict adherence to a plan of treatment, such as this, with the same vigor as is used in upper abdominal or vascular surgery, should reduce the mortality from perforated appendicitis to a minimum.

717 Broadway (Dr. Bolman)

DISCUSSION

DR. HERBERT H. DAVIS, Omaha: I wish to congratulate Drs. Bolman, Lloyd, and Johnson for their perfect survival rate in 391 cases of perforated appendicitis. Their success was due to sound surgical principles, fine judgment, and strict attention to details.

Before the era of antibiotics the manipulation during surgery in perforated appendicitis had great danger of causing a fatal spread of the infection. In patients with fairly diffuse peritonitis and temperature above 102 F, operated upon immediately by Dr. B. B. Davis and me, the mortality was 81%. In succeeding years we did not operate at this stage, and the mortality dropped to 8%. Recently antibiotics have greatly decreased the danger of spreading the infection by operation. In fact, the antibiotic can contact the bacteria easier than when they are in pus, walled off by a protecting wall of leukocytes.

In perforated appendicitis, bacteria-laden pus and feces are discharged into the previously sterile peritoneal cavity. Laxatives and food increase the peristalsis and the amount of leakage. Due to peritonitis, the capillaries in this area distend and leak water, electrolytes, and protein. The plasma volume is decreased, and, if this process is extensive, blood pressure is reduced, and shock ensues. The irritating effect of the peritonitis usually causes varying degrees of paralytic ileus with distention and vomiting, resulting in loss of chlorides and production of alkalosis. The bowel distention impairs the capillaries in its wall, so that they leak plasma, causing bowel wall edema and discharge of fluid into the bowel lumen and outward into the peritoneal cavity. Therefore, the blood volume is further decreased, and shock is increased.

This chain of events may be prevented by early appendectomy. If peritonitis occurs in the neglected or wrongly diagnosed patients, the authors have rightly advised a few hours of treatment to prepare the patient for operation. Antibiotics, usually penicillin and streptomycin, are given to kill bacteria which will be spread by the operative manipulation. A Levin tube helps put the bowel at rest and decreases distention and vomiting.

Intravenous fluids with the proper electrolytes replace the plasma loss and correct the alkalosis. After this preparation the operation is much less dangerous. The appendix is removed, which includes the perforated area, and much of the pus and bacteria are removed, so that there is much less infection to be overcome by the patient's natural resistance and by the antibiotics. With each new generation of surgeons disastrous attempts to irrigate the peritoneal cavity were made. Antibiotics now have made peritoneal lavage possible and probably even advisable.

Antibiotics, gastric suction, and use of proper fluids, electrolytes, and occasionally blood transfusion have greatly decreased the danger from ruptured appendicitis. However, all efforts should be made to do the appendectomy early in the attack before the appendix has ruptured. This decreases the morbidity and the risk of subsequent adhesions.

Dr. Chester C. Guy, Chicago: This interesting paper by Dr. Bolman and his associates suggests again that the last word has certainly not been said on the still very important subject of acute appendicitis. They indicate that all these 391 patients had some degree of peritonitis, varying from a localized process or abscess to a diffuse peritoneal infection. Their admirable record of having had no deaths in this group is remarkable in view of the advanced age of many of these patients and the number of serious postoperative complications which they encountered. It is of interest that they list no postoperative pneumonias as having occurred. I feel sure that their careful attention to preoperative and postoperative management has been a major factor in their handling of this large group of patients without a fatality.

To be constructive, the discussant of such a paper should indicate wherein he agrees with the authors and how he may disagree. I would highly approve of the authors' use of the McBurney incision placed more laterally than was originally described, but I would not recommend that it be used routinely, particularly in women. In these, I believe the low paramedian incision is preferable, even when the diagnosis seems to be clear-cut. We all know that a leaking cyst of the left ovary may closely simulate acute appendicitis and that it cannot be dealt with through a McBurney incision without considerable mutilation of the abdominal wall. I approve and practice the procedure of washing out the pelvis and wound layers when any appreciable degree of peritonitis is encountered. I also agree with the authors that drains should not be put into the peritoneal cavity but that adequate drainage of the incision down to the peritoneum or into the retroperitoneal space is of value. I also endorse their objection to the use of posterior pituitary injection or neostigmine bromide in cases of peritonitis.

There are three procedures which they have recommended to which I would take exception. One is the prolonged use of gastric suction if there is no abdominal distention or vomiting. The second is the use of the single blood transfusion if there is no anemia and the patient is not critically ill, and the third is the use of the free omental fat graft. The limitations of the latter procedure were described by Dr. Black and his Rochester associates at our meeting a year ago. I believe that there is little use for a free omental graft if the closure of the appendiceal stump is secure, and no indication for it at all if the omentum is long enough to bring down over the cecum. The proper handling of the stump has long been controversial. If it is healthy and securely ligated, I do not believe that it makes any difference whether it is inverted or not. We do not practive inversion without ligation.

Now, I would like to discuss one aspect of this paper, which I am sure has impressed many of you, and that is the criteria on which the authors have made the diagnosis of perforated appendicitis.

Illinois Central Hospital
Chicago

Acute Appendicitis — Operated

Four Years 1952–1955, incl.

Surgeon's Diagnosis

Acute appendicitis	148	75%
with abscess	11	25%
with gangrene	15	
with perforation	21	
Total	195	

On our service at the Illinois Central Hospital, in the last four years, we have operated upon 195 patients who have suffered from acute appendicitis, and these cases have been filed under the surgeon's diagnosis, as is here shown. I might say that this does not include the cases where the surgeon diagnosed acute appendicitis and the pathologist disagreed with him. This slide indicates that approximately 75% of our cases have been what may be called simple, acute, uncomplicated appendicitis, although, of course, most of these have had some degree of at least localized peritonitis. Twenty-five per cent of our cases have been complicated by the presence of frank abscess, obvious gangrene of the appendix, or obvious perforation of it. I am not sure that this is the ideal way to classify these cases, and certainly most of those patients with an abscess also have a perforation. The fact remains, however, that we all see appendices that are almost completely gangrenous, yet there may be no actual perforation and no marked peritonitis even of a localized type. Now,

I would assume that the incidence and pathology and complications of appendicitis in Fort Wayne, Ind., should be about the same as in Chicago, Ill. If this is true, then during the 10 years that the authors handled 391 cases of perforated appendicitis, it would be expected that they operated on hundreds of other patients who had acute simple or uncomplicated appendicitis. I would like to ask Dr. Bolman if this has been the case; if not, it would seem that patients with appendicitis are coming to him for operation after perforation, and much later than they come to us in Chicago. Finally, I believe that it is fair to ask the authors what criteria they use in making the diagnosis of perforated appendicitis, particularly in view of the fact that they have stated, and we will all agree, that the mortality in this type is higher than in the simpler unperforated type.

Dr. E. Lawrence Keyes, St. Louis: I compliment Drs. Bolman, Lloyd, and Johnson for treating appendicitis successfully after perforation. Before perforation, there occurs a common symptom, useful in early diagnosis though unfamiliar to some of you, called the gas stoppage sensation. It comprises (1) downward urge and (2) pain, despite defecation, persisting.

1. Downward urge was known to Fitz in 1886 as a demand for a laxative by the patient with appendicitis. This urge Harvey Cushing himself must have felt in 1897, at the 5th hour of his appendicitis, when as he wrote, he "took Gr. 1/6 of calomel for progressive cramps, pretty constant, after a wretched dinner"; at the 20th hour his "diseased appendix lying deep in the pelvis" was removed by Halsted and Finney. However, neither Halsted nor Finney considered the urge which Fitz described and which caused Cushing to take calomel at the fifth hour to be characteristic of appendicitis. Nevertheless, since 1941 some of us have considered downward urge characteristic, for during the first eight hours we have found it present in 83 of 100 patients with acute appendicitis but absent in 87% of 64 patients with other acute abdominal conditions. Furthermore, we have found downward urge twice as common as nausea and vomiting early in appendicitis. Finally, we have found downward urge in 16 of 18 patients early during nonlocalizing appendicitis.

2. "Pain, despite defecation, persists in appendicitis," wrote Edward P. Richardson in 1930. When my own appendix perforated in 1941, pain, despite some relief from enema at the 7th hour, persisted 36 hours, feeling like gas stopped up throughout my abdomen. In like manner, pain, despite defecation and despite passing gas, persisted before localization, 22 hours on the average, in 98 of our 100 appendicitis patients. By contrast, in 150 enteritis patients we found that the initial midline pain failed to persist despite defecation; pain was completely but intermittently relieved by defecation for from 1 to 20 minutes, and the whole attack terminated usually within 8 hours. "The relief from evacuation of the bowel (in enteritis) is greater than in appendicitis" was all Richardson found in 1930. In conclusion, there was only one exception to the rule that the gas stoppage sensation was distinctive of early acute appendicitis; we found, namely, in complete obstruction of the ileum, that pain began also with downward urge and persisted in the midline of the abdomen, despite defecation, longer than eight hours, as in acute appendicitis.

Dr. Willard Bartlett, St. Louis: I want to ask Dr. Bolman's indulgence for relating a personal story, whose point is not necessarily pertinent only to his title of "Perforated Appendicitis." Yet, I think it important that this audience be reminded of this point, since many of us not only teach medical students directly but also influence the attitudes of other surgeons in private, general hospitals.

Just over two months ago my 16-year-old son had appendectomy for mild, acute appendicitis performed by one of my personal friends, a most excellent surgeon, not a member of this Association. He did not bounce out of bed after the operation, and when he had a large bloody stool on the third day, it was found that his hemoglobin was 8 gm. and his hematocrit 22. He had bled into the colon from the inverted stump of the appendix. It was only then that I learned that the stump had not been ligated prior to inversion by purse-string suture. I won't repeat the details, which you can foresee, of the sequence of events that followed reopening of the unprepared cecum and suture of the bleeding mucosa. There were massive shifts of electrolytes, peritonitis with ileus, and recurring small intestinal mechanical obstruction which was eventually treated with long-tube decompression; in the fourth week, the long tube could not be withdrawn after one episode of decompression, and laparotomy was again performed to free the tube. Again, a massive electrolyte and fluid shift occurred, during which the boy was in most critical condition for a greater number of hours than I care to contemplate. Upon discharge from the hospital six weeks after appendectomy, since he had had oral nourishment for only six or seven days at intervals, his weight had gone down from 140 to 110 lb. He is now making an excellent recovery of his weight and strength, and we believe that he has used up his bad luck.

All of this seems to me a very high price to pay for the omission of a ligature about the stump of the appendix, whether or not one proposes to invert it. My father was a lifelong advocate of inversion without ligation, and two of the surgeons who saw my youngster in consultation stated that they did not themselves ligate

the stump. Yet, instances of hemorrhage into the bowel from the unligated stump have appeared for a great many years, and for that reason I personally abandoned this technique in the '30s.

There are theoretical objections to each of the three principal methods of dealing with the appendiceal stump, yet, reflection will show that only hemorrhage is apt to be catastrophic, since it usually enforces immediate secondary operation. To those of you who would say that this happens rarely, I can only answer that you will not be consoled by this knowledge when the life of your own son is at stake.

DR. ARNOLD JACKSON, Madison, Wis.: One of our hosts, Dr. Altemeier, said yesterday that any one who presented an idea at these meetings should have to return five years later and review what happened.

About 10 years ago, I think it was, at our Memphis meeting I presented a small series of cases, with the title of "Nondrainage and Early Ambulation in Cases of Perforative Appendicitis."

I took a poll of the members of the Association at that time, and about 65% opposed the idea. As a matter of fact, I was severely taken to task by our President, Dr. Bob Sanders, whom I asked to discuss it, and also by my brother James, whom some of the older members will remember. But I am very pleased to see that in Dr. Bolman's last 250 cases he has closed without drainage.

I have never used drainage since the time I first reported this, and I have never had occasion to regret it.

There have been no wound infections and no complications, and I think that has been a great forward step.

I do disagree in the fact that we have used spinal anesthesia in all our cases and feel that it has many advantages. This, though, is probably of slighter importance than the drainage and early ambulation problem. I feel that this is a splendid contribution that these authors have made, and they deserve great credit.

DR. R. MORTON BOLMAN, Fort Wayne, Ind.: I would like to thank all the discussants for their fine discussion, and if I may rapidly, I will answer the questions that were brought up.

I want to thank Dr. Davis particularly for bringing out again that antibiotics, in the present mode of preparation and treatment, do to a certain extent do away with the old adage of staying inside the inflammatory wall, because it seems to us that, by staying inside the inflammatory wall, one is setting up the next complication, in other words, the abscess. Our attitude is a hard thing to define. I believe the thing to which we humbly attribute this series is the feeling that, to get by with a live patient, the more nearly one can avoid any complication at all, the better chance the patient has, because complications seem to be a chain reaction in our hands.

As I left home, I had a patient on whom I had opened subdiaphragmatic abscesses on both sides—in 10 days the first on the left side and in 17 days the second on the right. She had been perforated for 10 days to 2 weeks, with generalized peritonitis before we saw her.

Dr. Davis mentioned pouring things into the abdomen. I remember as a little boy going with my father and watching him, when he finished a ruptured appendicitis, pour a can of ether into the abdomen.

As to Dr. Guy, he brought up a question which I appreciate very much. As far as the Levin tube is concerned, we use it routinely for the reason that we find we are not able to pick out the patient who will develop an ileus. Since we have no way to predict which one will, we prefer to protect all the patients from the sometimes disastrous effects of ileus.

In reviewing a large series of cases with mortality in our town, we found that the only difference between the care we gave our patients and the care given patients who died was that the Levin tube was not put in the other patients until the second or the third day when distention was already present, electrolytes depleted, and the patient more tired than after the original procedure.

It is certainly a controversial point, but in our case anybody that has been associated with us knows that, if the operation is done during the night, there had better be a Levin tube in the next morning.

As far as the McBurney incision is concerned, we use it routinely, and on six cases I have closed the McBurney incision and moved over to the midline owing to a wrong diagnosis.

The one case that sticks out in my mind most is a stem pessary that was put in and forgotten. It eroded into the abdominal cavity and could not be taken care of through a McBurney incision. The only complication I could see was that the patient had two scars instead of one.

I have made enough mistakes certainly, so that there are two incisions on quite a few patients, but I think the importance of that is somewhat overexaggerated. The most important thing is not hesitating to start over.

As far as the blood transfusion is concerned, I agree with Dr. Guy who said that to routinely give anybody blood for anything is poor. The danger inherent in blood transfusion is great enough and the human factor serious enough, so that one should not say that he does anything routinely, least of all giving blood.

We lost a patient from having received a bottle of somebody else's blood. Certainly I think I deserve criticism on that point.

Now, Dr. Guy wants to know what our criteria are for perforated appendicitis. They are the same as anybody else's, a hole in the appendix and one of Schullinger's five types of peritonitis.

Now, it is perfectly logical to wonder how anyone could find and operate upon this number of cases of perforated appendicitis in a town of 150,000 persons. First, we service an area of 300,000 persons. These operations were done in three hospitals in our town and in five rural hospitals as far as 60 miles away from Fort Wayne—a practice which we discontinued about two or three years ago. We have shown movies and given talks on this subject locally, at county level, and at state level.

Dr. Guy asked the question, which I can also understand, If we had 391 cases of perforated appendicitis, how many unperforated ones must we have had?

Inasmuch as there are 204 physicians in our town and 198 of them surgeons, they all did what they called "ordinary" appendectomies. The only cases they were glad to see a young surgeon about were the ones that looked as if they were going to die. It looked to me as though the only way one could get started was, "If you can't lick 'em; join 'em." So, I talked about ruptured appendicitis, since it was so plentiful. I made movies, talked to local medical societies, county medical societies, state medical societies, and some county medical societies far away.

There are 12 physicians who sent us cases of perforated appendicitis who have never referred us another case. In other words, as to how many unruptured cases we have had, Dr. Guy will be surprised to know that, whereas we have had 391 perforated cases, we have operated upon 326 unperforated cases.

Now, I am very happy to say that the thing has corrected itself, and the surgeons are doing a much higher percentage of this surgery originally.

The only other recommendation I can make, if you want to build a series like this, is to choose your referring physicians. I had one physician who for five consecutive years sent us well over 30 cases of appendicitis a year, and we could always depend on more than half of them being perforated. He has now entered an allied specialty, so that the series will accumulate much more slowly in the future.

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Meconium Ileus and Meconium Peritonitis

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Meconium ileus is one of the manifestations of fibrocystic disease of the pancreas. Intestinal obstruction in an infant is always a serious problem. When the obstruction is due to meconium ileus, the problem is doubly serious, because successful surgical relief of the obstruction may be followed by other complications of fibrocystic disease of the pancreas.

Landsteiner,[14] in 1905, published the first description of associated fibrocystic disease of the pancreas and meconium ileus. The generally accepted cause for the thick, ropy, inspissated meconium is a deficiency of the enzymatic secretion of the pancreas (Fig. 1). In observations reported by Hurwitt and Arnheim,[13] Andersen,[2] and Farber,[8,9] the pancreatic ducts were obstructed owing to either inspissated secretions or congenital stenosis. About 10% of patients with fibrocystic disease of the pancreas have meconium ileus at birth.[6,11,25] The incidence of fibrocystic disease of the pancreas is approximately 0.16% of all live births.[6]

Excellent descriptions of pathologic alterations in the pancreas and other organs have been made by Farber,[8,9] Andersen,[2] and di Sant'Agnese.[6]

Meconium peritonitis may accompany meconium ileus if a prenatal perforation of the intestine occurs. The perforations are usually found in the distended segment of the intestine proximal to the obstruction. Meconium peritonitis has also been found in association with other types of congenital intestinal obstructions. It is of considerable interest that meconium peritonitis may occur without coexisting intestinal obstruction. In some of the patients who had meconium peritonitis without obstruction, fibrocystic disease of the pancreas was present.

Fig. 1.—Photograph taken at operation showing thick, ropy meconium.

Clinical Features

The characteristic clinical features are vomiting, abdominal distention, and failure to expel meconium stools.

The vomiting is persistent and usually follows attempts to feed the patient. Marked abdominal distention is usually present, and dilated superficial veins are often seen in the abdominal wall (Fig. 2). The distention is commonly present at birth and thus differs from that caused by congenital atresia which does not appear until some hours after birth when the intestines contain air. Failure to pass meconium stools is an important finding, and on digital rectal examination no

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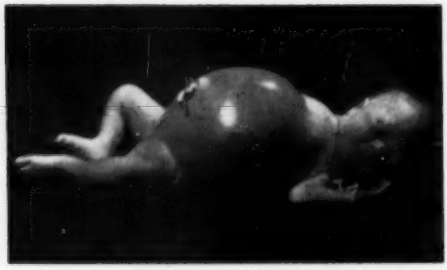

Fig. 2.—Infant with meconium ileus. Note marked abdominal distention and visibly dilated veins.

meconium is obtained. In addition, the anus and distal rectum are often narrowed and resist passage of the small finger for more than a distance of 2 to 3 cm.

Abdominal masses consisting of meconium are occasionally palpated in the lower right quadrant. In this series the presence of a mass was recorded only three times. Severe distention may obscure a mass.

The occurrence of the disease in more than one sibling has been observed frequently in other series as well as in ours.

All the patients were admitted to the hospital between the ages of 3½ hours and 4 days.

No significant difference in occurrence in either sex was noted.

Roentgenographic Findings

Roentgenograms should include films made in both the supine and the upright position.

In patients with meconium ileus the findings may be difficult to differentiate from other types of obstruction. Dilated loops of small intestine proximal to the obstruction and collapsed intestine distal to the obstruction are seen. The colon ordinarily contains no air. Gross [10] has emphasized the great variation in the size of the distended intestinal loops and the mottled or granular appearance of the inspissated meconium in those areas where it is concentrated. Neuhauser [18] observed in several patients with meconium ileus that there was no abrupt termination of the visualized gas and no terminal dilated loop of bowel to suggest a point of obstruction. Small quantities of gas had been forced into the tenacious obstructing meconium and could be seen as minute bubbles scattered throughout the distal small bowel. White [23] called attention to the absence of fluid levels in the upright roentgenograms (Fig. 3). In obstructions of the small intestine from other causes, fluid levels are usually present. In cases of meconium ileus accompanied by gangrene, volvulus, or peritonitis, the absence of fluid levels was not observed. The description of these changes was made by White without the knowledge that they had previously been recorded by Zimmer.[24]

Roentgenographic features of meconium peritonitis are variable. The entire abdominal area may be diffusely opaque if considerable fluid is contained in the peritoneal cavity. Irregularly dilated loops of intestine may be seen if there is an associated ileus. If a perforation is present, fluid may collect between the intestinal loops, and free air may be present in the peritoneal cavity. The most important roentgenographic evidence of meconium peritonitis is the presence of calcium in the peritoneal cavity. Calcification

Fig. 3.—Upright roentgenogram of patient with uncomplicated meconium ileus. Fluid levels are absent (White's sign).

Fig. 4.—Extensive peritoneal calcification in patient with meconium peritonitis.

is not always present but was seen in three of the five patients in this series. It may be manifested by a small isolated area, or it may be quite extensive. (Fig. 4).

Treatment

In patients with uncomplicated meconium ileus, the surgical treatment was essentially enterotomy, removal of the thick meconium, instillation of a solution containing pancreatic substance, and closure of the enterotomy.

The insertion of a polyethylene tube in the internal saphenous vein at the ankle was a routine preoperative procedure. A right paramedian abdominal incision was then made, and the rectus muscle was retracted laterally. After the peritoneum was opened, the meconium-filled intestinal loops were easily identified. Usually the terminal ileum was the site containing the obstructing meconium, but in one patient thick meconium extended from the distal one-third of the small intestine to the middle of the transverse colon. Isotonic saline solution was injected through a No. 18 needle to distend the intestine and separate the intestinal wall from the contained meconium. The needle punctures were made at locations where removal of the meconium would be most easily accomplished and most effective. Enterotomies were then done at these sites. In two patients two enterotomies were necessary in order to remove all the meconium. We were unable to successfully remove the meconium by continued irrigation through a catheter, as reported by Hiatt and Wilson.[11] Gross [10] also expressed dissatisfaction with attempts at removing the meconium by irrigation. Actually, in order to evacuate the intestine, in most instances the meconium was removed with forceps aided by manual compression of the involved loops. After the meconium was removed, the patency of the intestinal tract distal to the obstruction was demonstrated by the injection of isotonic saline solution. Two grams of pancreatin (Panteric) granules in 10 cc. of water or four grams of Viokase (a pancreas preparation) in 50 cc. of water were then introduced into the intestinal lumen, and the enterotomy openings were closed.

Patients in whom meconium ileus was complicated by volvulus, gangrene, perforations, or meconium peritonitis often required resections in addition to removal of the meconium. These procedures were frequently difficult and adversely affected the results. The surgeon has no standardized operation to perform on patients with complicated meconium ileus or severe meconium peritonitis. He must act according to the demands of the situation encountered.

Postoperatively, the treatment administered was directed at the associated mucoviscidosis. The essential feature of this phase of the therapy is a high caloric, high protein, and high simple sugar diet which is low in fat. Water-miscible vitamins (vitamin D, 2000 units; vitamin A, 10,000 units; vitamin B complex and ascorbic acid, 100 mg.) and pancreatic extracts (Viokase or Panteric granules) are important adjuncts to the diet. Salt should be used liberally, and additional amounts are necessary in hot weather. Antibiotics are administered prophylactically as long as there is evidence of

Fig. 5.—Patient shown in Figure 2 six months postoperatively.

pulmonary involvement. All possible efforts should be made to prevent the occurrence of acute infectious diseases. Detailed accounts of this phase of the treatment have been published by Gross [10] and di Sant-'Agneses.[6]

Results

All the patients in this series were admitted to the hospital since 1950. Thus, our experiences cover a six-year period. The patients who survived had the usual laboratory determinations to establish the presence or absence of fibrocystic disease of the pancreas. These included examination of the duodenal contents for pancreatic enzymes, trypsin digestion of the stools, vitamin A absorption determinations, and, more recently, the estimation of sweat electrolyte concentrations. All the survivals occurred in the last four years. Necropsies were performed on all the patients who died.

The patients with uncomplicated meconium ileus are described in Table 1. Six (86%) of the seven patients treated by enterotomy and removal of the meconium recovered satisfactorily. However, two of these patients died later of fibrocystic disease of the pancreas. One patient (case 8) was moribund on admission, and no operation could be performed. He was cyanotic, hypotonic, and, despite the institution of emergency measures, died a few hours after admission. It is of interest that the brother of one patient (Case 7) had a stenosis of the terminal ileum and associated fibrocystic disease of the pancreas but did not have meconium ileus. He was successfully operated upon by one of us (W. J. P.) and is progressing satisfactorily at the present time.

In Table 2 the results in patients with complicated meconium ileus are tabulated. None survived, and the problems encountered in their management were difficult. In one patient (case 1) the outcome could be attributed to gangrene and perforation of a

TABLE 1.—*Uncomplicated Meconium Ileus*

Case, No.	Operation	Result of Operation	Remarks
1	Enterotomy; meconium removed	Satisfactory	Fibrocystic disease of pancreas
2	Enterotomy; meconium removed	Satisfactory	Fibrocystic disease of pancreas
3	Enterotomy; meconium removed	Satisfactory	Fibrocystic disease of pancreas
4	Enterotomy; meconium removed	Satisfactory	Fibrocystic disease of pancreas
5	Enterotomy; meconium removed	Satisfactory	Died at 5 mo. of age; fibrocystic disease; intestinal obstruction
6	Enterotomy; meconium removed	Satisfactory	Died at 20 mo. of age; fibrocystic disease; bronchopneumonia
7	Enterotomy; meconium removed	Death	Fibrocystic disease; atelectasis; peritonitis
8	None	.....	Moribund on admission; necropsy showed fibrocystic disease and meconium ileus

TABLE 2.—*Complicated Meconium Ileus*

Case, No.	Findings at Operation	Operation	Necropsy
1	Meconium ileus with volvulus of midgut; 45 cm. of gangrenous small intestine	Resection of gangrenous intestine; reduction of volvulus; removal of meconium	Fibrocystic disease of pancreas; gangrene and perforation at anastomosis; peritonitis; subphrenic abscess
2	Inspissated meconium in large and small intestine	(1) Enterotomy; meconium removed (2) Reexplored; adhesions freed	Agenesis of myenteric plexus, large and small intestine; no fibrocystic disease of pancreas
3	Severe meconium peritonitis; perforation of jejunum; meconium ileus	(1) Resection and double-barrelled enterostomy (2) Revision enterostomy	Fibrocystic disease of pancreas; meconium ileus; meconium peritonitis; bronchopneumonia
4	Large amount of fluid; volvulus; gangrene with perforation of a twisted loop; severe meconium ileus	Resection of gangrenous bowel; reduction of volvulus; removal of meconium	Meconium ileus and peritonitis; atelectasis; fibrocystic disease of pancreas

small area in the intestine just proximal to the anastomotic suture line. In the other three patients the fatal outcome seemed inevitable in spite of the surgical efforts. It is interesting that one patient (case 2) did not have fibrocystic disease of the pancreas. The meconium ileus was associated with agenesis of the myenteric plexus of both the large and the small intestine. This is to our knowledge the only such case that has been described.

From Table 3 it is evident that meconium peritonitis without meconium ileus is a serious disease. Three patients died, and all had associated fibrocystic disease of the pancreas. One patient (case 5), not operated upon, had abdominal distention and calcification on the abdominal roentgenogram. However, passage of meconium stools and continued improvement led to nonoperative management. Subsequent diagnostic procedures demonstrated the existence of fibrocystic disease of the pancreas.

The other patient (case 2) who survived had extensive meconium peritonitis, a large amount of fluid in the peritoneal cavity, and an isolated perforation of the splenic flexure. Surgical closure of this perforation was followed by a satisfactory result. This patient did not have fibrocystic disease of the pancreas, and his case is similar to several of the cases described by Paltauf and Hughes. The ocurrence of meconium peritonitis with or without a demonstrable intestinal perforation has been recognized, particularly by pathologists, for many years.[4]

Comment

If patients with meconium ileus are successfully relieved surgically of their obstruction, subsequent management of the associated fibrocystic disease largely determines the prognosis. Almost all these patients have pulmonary involvement and experience difficulty in getting rid of viscid bronchial secretions. Because of the increased loss of

TABLE 3.—*Meconium Peritonitis (Without Meconium Ileus)*

Case, No.	Findings at Operation	Operation	Result	Necropsy
1	Severe meconium peritonitis; calcification	Double-barrelled enterostomy	Death	Fibrocystic pancreas; meconium peritonitis; bronchopneumonia; acute ventriculoencephalitis
2	Meconium peritonitis; calcification; perforation, splenic flexure	Isolation of splenic flexure from adhesions; perforation closed	Satisfactory; no fibrocystic disease	
3	Meconium peritonitis; calcification; gangrene and perforation of terminal ileum	Resection of ileum; end-to-end anastomosis	Death	Fibrocystic pancreas; meconium peritonitis; pneumonitis
4	Meconium peritonitis; dense adhesions; obstructing ileum	Freeing of adhesions to relieve obstruction	Death	Fibrocystic disease; meconium peritonitis
5	No operation—calcium deposits in abdomen		Satisfactory; has fibrocystic disease of pancreas	

electrolytes in sweating, susceptibility to heat prostration is a constant danger in hot weather. Focal biliary fibrosis, probably due to inspissated secretions obstructing the hepatic ducts, has been observed. In some patients this process goes on to a diffuse hepatic cirrhosis.

The first successful results in the surgical treatment of meconium ileus were described by Hiatt and Wilson [11] in 1948. The procedure used by us is essentially similar to theirs. Gross [10] has satisfactorily used a Mikulicz resection of the distended terminal ileum and a double-barrelled enterostomy. After two or three weeks the enterostomy, which is exteriorized through a left McBurney incision, is closed. In 19 patients treated by this method, there was a 79% survival rate. Throckmorton and Porter [21] reported two patients who were successfully managed by primary side-to-side ileotransverse colostomy and complementary proximal Witzel ileostomy, a single-stage procedure.

Boikan [4] ably described the historical and pathological aspects of meconium peritonitis. In 1943 the first survival of a patient with meconium peritonitis who was treated surgically was reported by Agerty, Ziserman, and Shollenberger. According to Weinberg and Paul,[22] at least 25 successful surgical cases have been reported since then. Besides the patient reported by Weinberg and Paul,[22] other reports of surgical survivals have been made by Low and associates,[16] Lee and MacMillan,[15] Bendel and Michel,[3] Neuhauser,[17] Conrad and Robbins,[5] Packard and Reynolds,[19] and Doyle.[7]

Most of these reported instances of meconium peritonitis followed perforations proximal to an area of congenital atresia. The patient of Weinberg and Paul [22] had no atresia but had associated fibrocystic disease of the pancreas. Many of the earlier accounts were of patients who showed no associated lesion at autopsy responsible for the meconium peritonitis.[4] In some of the patients, the perforation in the intestine could be identified; in others, spontaneous closure apparently occurred.

In our patient (case 2, Table 3) with the perforation of the splenic flexure without associated mucoviscidosis, the calcification on the roentgenogram was striking. Subsequent films have shown no decrease in the calcification over a period of one year. This is in contrast to the patient reported by Low and associates where the calcification partially disappeared.

Summary and Conclusions

Meconium ileus and meconium peritonitis are serious disorders which only recently have been managed surgically with any degree of success.

Surgical treatment of uncomplicated meconium ileus in eight patients was followed by one death, or an operative mortality of 14%.

Four patients with complicated meconium ileus were treated surgically without success.

Meconium peritonitis without meconium ileus was accompanied by an operative mortality of 60% (three cases). One patient survived satisfactorily without operation.

Late results in these patients are influenced by the severity of the associated fibrocystic disease of the pancreas.

6710 W. North Ave. (35) (Dr. Fox).

DISCUSSION

Dr. Clifford D. Benson, Detroit: I have enjoyed this excellent presentation by Dr. Fox and Dr. Potts very much because it offers further

Table 4.—*Summary of Results*

	Patients, No.	Operations, No.	Operative Deaths, No.	Nonoperative Deaths, No.	Mortality, per Cent
Uncomplicated meconium ileus	8	7	1(14%)	3	50
Complicated meconium ileus	4	6	4	0	100
Meconium peritonitis	5	4	3	0	60
Totals	17	17	8(47%)	3	65

evidence that some of the infants can be successfully treated for acute and lethal obstruction in the first few days of life.

Our experience with these lesions extends over a period of years, and it has been only in the past few years that our operative results have been improved. In meconium ileus we practiced enterotomy and the irrigation with saline in a good number of patients, and we never were satisfied with our ability to free the meconium from the bowel even though this was given extensive trial. The results were uniformly fatal. It has been shown that hydrogen peroxide breaks up the surface tension between the meconium and the mucosa, and this is the first agent that we have used that has enabled us to free the meconium satisfactorily and with a minimum of trauma to the bowel wall.

Within the last four months I have had two female patients, one aged 4 hours and the other 3 days old, with meconium ileus and obstruction. In the patient who was 4 hours old when the abdomen was opened, there was evidence of a complete plugging of the distal 18 in. of the ileum, with an old perforation, just proximal to the inspissated meconium. An enterotomy was done at this point, and the bowel irrigated with hydrogen peroxide, and we were able to separate the meconium very nicely.

Two large plugs were milked into the cecum. The bowel wall in this area was quite necrotic; therefore, after completing the emptying of the bowel, we resected the site of the old perforation and did an end-to-end anastomosis with proximal enterostomy, and this patient's postoperative course was uneventful. Trypsin studies showed no trypsin in the duodenal contents, confirming the diagnosis of pancreatic fibrosis or mucoviscidosis.

The second infant, 3 days old, was acutely obstructed, and in this particular patient a barium enema showed the colon outlined in the distal portion with no abnormality, except that it was of the microcolon type, indicating complete obstruction in the terminal ileum. An enterotomy was done in the terminal ileum, and the extent of obstruction due to inspissated meconium was 12 in. of the terminal ileum; the peroxide-solution irrigation cleared all contents completely, with milking. A small rubber catheter was allowed to remain in the ileotomy wound for decompression. We have discontinued the use of pancreatin solution through the enterotomy tube in the early postoperative period, because it is too irritating to the bowel wall and may be a factor in breakdown of the suture line.

Both of these infants left the hospital on the 21st postoperative day and have continued to do well at home. They have been carried on a normal diet with the addition of the pancreatic preparation, Viokase. We have found that the amino acid mixture Nutramigen is excellent in providing these patients with added protein. It has been pointed out by Gross that the total caloric value of the diet should be greatly increased, as much as 40% above that offered a normal baby at the same age. These patients should be carried on daily antibiotics to try to prevent pulmonary infection. Oxytetracycline (Terramycin) has been most useful in this respect.

At the recent meeting of the Surgical Section of the American Academy of Pediatrics, Dr. Thomas V. Santulli presented an excellent study of neonatal obstruction at the Babies Hospital from 1939 to 1955. In this period they had a total number of 37 cases of meconium ileus, and there were 25 operative deaths.

Of the 12 patients who survived operation, 7 died later of pulmonary infection, and 1 died of malnutrition and dehydration. As of January, 1956, there were only four living, or 11%.

It is significant in this study that, of the four surviving patients who were relieved of their original obstruction at birth, three (aged 8½, 2¾, and 2¾ years, respectively) are progressing normally, and their chest films show no disease. The remaining survivor was 2⅓ years following operation, and this patient has had 10 admissions to the hospital because of obstruction and severe pulmonary changes, and the eventual prognosis is poor.

As Dr. Santulli has said, "This is not too glowing a story," but I am sure his excellent follow-up studies of these patients stress the point that long follow-up is necessary to evaluate the results on these patients and, furthermore, serve as a guide as to a guarded prognosis to the parents of these infants.

In summary, the immediate obstruction associated with meconium ileus and meconium peritonitis can be better met with using our present methods than formerly; and the fact that infants who do survive the operation can live a normal life and are free of pulmonary infection can probably be attributed to the fact that there is a variation in the severity of this disease.

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Primary Hemicolectomy for Perforated Lesions of the Right Colon

LEON J. WITKOWSKI, M.D.; GUY V. PONTIUS, M.D., and RAYMOND E. ANDERSON, M.D., Chicago

Not all patients with right-sided abdominal pain and associated inflammatory signs have acute appendicitis. When the usual surgeon finds unusual pathology coupled with evidences of peritonitis, he naturally inclines toward conservative action. The old adage, "The surgeon should run when the pus runs," is not sound surgical judgment in all cases. When one unexpectedly encounters a perforated lesion of the right colon in a completely unprepared patient, he must consider the possibilities of the pathology involved and the consequences of an inadequate procedure.

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Inflammatory lesions of the colon cannot always be distinguished from neoplastic ones. This lack of certainty is admitted by our most experienced surgeons. One must therefore at times base his judgment on probabilities. From a statistical viewpoint one must assume that a perforated right colon lesion is a carcinoma. Although the frequency of cancer of the left colon is emphasized, cancer of the right colon is not a rarity. Allen and Welch's series of 634 colon cancers show the cecum and ascending colon involved in 25.5%. Wilkie's [1] series shows a similar incidence (Fig. 1). It is even less appreciated that 4%-5% of the right colon cancers perforate as their primary symptom.[2]

ALLEN AND WELCH GIVE THE DISTRIBUTION IN THEIR 634 CASES OF CANCER OF THE COLON AS FOLLOWS

SIGMOID COLON	53.9 %
CAECUM AND ASCENDING COLON	25.5 %
TRANSVERSE COLON	11 %
SPLENIC FLEXURE AND DESCENDING COLON	9.6 %

THE SITE OF GROWTH IN 243 CASES OF CANCER OF THE COLON (WILKIE):

CAECUM	6.9 %
ASCENDING COLON	12.7 %
HEPATIC FLEXURE	2.1 %
TRANSVERSE COLON	9.5 %
SPLENIC FLEXURE	4.9 %
DESCENDING COLON	8.2 %
PELVIC COLON	55.5 %

Fig. 1.—Cancers of the cecum and ascending colon approximate 20%-25% of all cancers of the colon.

Excluding appendicitis, cancer is the commonest lesion causing right colon perforation.

Much has been written about perforated diverticulum of the right colon. This is not a common lesion. Isolated diverticulum of the right colon has an incidence of 0.1%.[3] The incidence of diverticular perforation is necessarily much lower. We are indebted to Anderson[4] for his comprehensive report on the treatment of solitary diverticulitis of the cecum. In his paper he advised local excision of the identifiable cases. The mortality from local excision was 1.6%, compared with a 7% mortality from hemicolectomy. We must assume that hemicolectomy was reserved for those cases with extensive inflammation prohibiting local removal. This 7% mortality was achieved prior to 1947, and we have every right to expect a lowered mortality today.

Another factor which contributes to the surgeon's uncertainty when dealing with an unidentifiable inflammatory mass of the right colon is the fear of amebic granuloma. Admittedly, amebiasis is an endemic disease, and Faust[5] believes that 20% of this country's population is infected. The bitter surgical experiences with acute amebiasis simulating acute appendicitis at the Chicago Worlds Fair of 1933 have been well publicized. Acute amebic colitis and amebic granuloma are different entities, and amebic granuloma of the colon is far less frequent than carcinoma. Recent reports indicate that amebic granulomata can be primarily resected without undue complication.[6]

Simple ulcers of the cecum are probably the most interesting lesions of the gastrointestinal tract. These ulcers of unknown etiology usually occur a few centimeters beyond the ileocecal valve.[7] They are usually on the medial aspect of the cecum, and approximately 65% exhibit perforation at surgery. They cannot be distinguished from cancer. They deserve primary hemicolectomy. With these thoughts in mind, we would like very briefly to present two cases.

CASE 1.—A 60-year-old woman entered St. Luke's Hospital 18 hours after the sudden development of acute lower abdominal pain. The pain was intense in character, exaggerated on motion and abdominal palpation. Maximum tenderness was located directly over McBurney's point. The patient had undergone appendectomy 10 years previous to this admission but had been unwell during the previous 3 years and had undergone three x-ray investigations of the gastrointestinal tract as well as proctoscopic and stool studies. All had been negative. The morning of her admission, in addition to her pain, she had associated inflammatory signs of fever and a white cell count of 14,700. Pelvic examination was negative, and a flat film of the abdomen showed no pathology.

With the advantage of having had recent negative x-ray films of the intestinal tract, a preoperative diagnosis of an acute inflammation of a long appendiceal stump or a possible Meckel's diverticulum was made. Exploration was carried out through a right lower quadrant muscle-splitting incision, and on opening the peritoneum there was an escape of cloudy fluid from which the usual coliform organisms were ultimately cultured. On further exploration, a large inflammatory mass was found in the region of the cecum, about 4 cm. distal to the appendiceal stump (Fig. 2). There was free pus lying along the lateral gutter, and it was our impression that we were dealing with a perforated carcinoma.

A resection of the terminal ileum, cecum, and ascending colon was accomplished with relative ease, and an end-to-end anastomosis was done. The right lateral gutter was not reperitonealized, but a Penrose drain was placed at this area and

Fig. 2.—Nonspecific cecal ulcer in its usual location in close proximity to the ileocecal junction.

let out through the inferior aspect of the wound. Postoperatively the patient did very well with the assistance of penicillin and dihydrostreptomycin (Combiotic) and tetracycline (Achromycin), and she was discharged on the 12th postoperative day without evidence of intraperitoneal or wound infection.

The pathologic report disclosed a perforated nonspecific chronic ulcer of the cecum along its anterior surface that measured about 3 cm. by 1 cm. Multiple histologic preparations of the ulcer were examined. They exhibited dense masses of polynuclear leukocytes and granular tissue debris. The granulation and scar tissue were nonspecific. Foreign-body structures could not be found, and amebas could not be demonstrated in the exudates of the ulcer.

CASE 2.—A 55-year-old white man entered St. Luke's Hospital complaining of abdominal pain. He had enjoyed good health until the previous morning, when he awakened with a dull ache in the epigastrium which gradually fixed to the right quadrant. On the morning of admission, he was seen by his family physician who made a diagnosis of acute appendicitis. The clinical story and laboratory findings substantiated this impression, and exploration was advised. With the patient under general anesthesia, a generous muscle-splitting incision in the right lower quadrant was made, and the peritoneum was opened with the escape of very cloudy fluid. This fluid at subsequent culture exhibited the usual coliform organisms. On palpation, there was marked induration of the appendix, and a tentative diagnosis of acute perforated appendicitis was made. With some difficulty the friable appendix was freed from numerous adhesions, and during this maneuver it fractured at its cecal base. Inspection of the cecum then revealed marked induration in the region of the appendiceal stump, and we felt that we were once again dealing with a primary tumor of the cecum with secondary acute appendicitis.

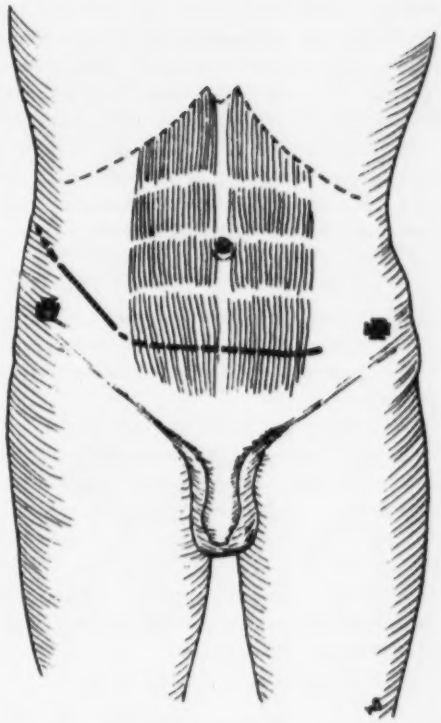

Fig. 4.—Solid line represents the usual McBurney incision. Dotted line represents extension for greater exposure.

Fig. 3.—Colloid carcinoma of the cecum with invasion of the proximal appendix causing acute perforated appendicitis.

A primary excision of the entire mass was then done with anastomosis between the ileum and the transverse colon. The operative wound was drained subcutaneously. The patient, with the assistance of the usual antibiotics, recovered without incident and was discharged on the 11th postoperative day.

The pathologic report showed a colloid carcinoma at the proximal end of the appendix, acute gangrenous appendicitis, and colloid carcinoma of the cecum (Fig. 3).

Summary

The majority of patients with perforated lesions of the right colon and particularly the cecum are preoperatively diagnosed as

having acute appendicitis. The patients are brought to the operating room with relatively little preparation, and on exploration through the usual McBurney incision the finding of perforated tumor with peritonitis may dissuade the operator from definitive action. Recent reports indicate that with the assistance of antibiotics the unprepared patient may be subjected to immediate hemicolectomy despite the certainty that a localized peritonitis is present.[8] The postoperative complications are not sufficiently frequent to postpone the excision of a pathologic process which most commonly is a perforated cancer.

We do not feel that a separate abdominal incision is necessary to accomplish this in all cases. Sufficient exposure may be obtained with a superior extension of the McBurney wound and a transverse extension of its inferior angle with severance of the right rectus muscle (Fig. 4). This will usually provide sufficient exposure and allow firm postoperative healing.

104 S. Michigan Ave. (3) (Dr. Pontius)

DISCUSSION

Dr. John Van Prohaska, Chicago: This indeed is an important presentation, because it deals with an elective, essential, and purposeful breach of a surgical principle. The importance of this procedure is more striking when we compare it with an unsatisfactory alternate therapy, that of either the exteriorization of the involved viscera or the short-circuit operation which would necessitate a second surgical intervention at a later date.

To perform a surgical procedure in the presence of pus requires a careful consideration tailored to the immediate needs of the patient. In this consideration the survival of the patient must be predictable, or the chance must be better than that offered by a more conservative procedure.

Every operative area has a stratum of dead cells, and it is altogether possible that in this area the existing bacteria may grow with increased virulence, because the dead tissue forms a choice medium for bacterial growth.

The problem of accurate diagnosis should not be difficult, because in doubtful cases frozen-section type of biopsy should be harmless, since the lesion is already ruptured.

Two other points should be emphasized. First, culture and sensitivity studies should be carried out on the pus obtained at operation in order to initiate proper antibiotic therapy as soon as possible.

Before the results of sensitivity studies are available, broad-spectrum antibiotics, such as the authors used, are proper. These should be given in large amounts intramuscularly and intravenously.

Drainage of the operative area is important for no other reason than to check periodically the draining material for sensitivity to antibiotics.

Lastly, the hazards of infection and the inflammatory reaction may compromise the radicalism of cancer surgery. For this reason some of these patients may be earmarked for an intentional second look six months after the original resection.

Dr. R. Morton Bolman II, Fort Wayne, Ind.: As Dr. Witkowski will remember, in the European Theatre of Operations at the start of the Second World War, the dictum of the theater was that anybody with a wound of the right colon had to be colostomized on the right side. Disastrous things resulted from this practice. The colostomies bled, the wounds broke down and eviscerated during evacuation, and all sorts of things.

A fine surgeon from California, whose name, I am sorry to say, eludes me, against the theater dictum began to do primary hemicolectomy for wounds to the right colon. He quickly found, and proved, that the mortality and morbidity, even with gross contamination, were much less than with colostomy. In the presence of inflammation or wounding, either one, there is helpful dissection of the right peritoneal reflection by the trauma.

I congratulate Dr. Witkowski for bringing up this controversial point, one in which certainly our group would agree with him.

In the removal of the right colon there is an old trick of Dr. William Mayo's that has been forgotten by many people. It is especially useful in the unprepared colon. He recommended a right hemicolectomy and an ileotransverse colostomy. Instead of closing the free proximal end of the colon blind, he brought it to the outside through the skin and inserted a No. 18 F. catheter through it and across the ileocolostomy as a decompression procedure for the protection of the anastomosis. The catheter was removed after bowel function was reestablished, and after a day or two no more fecal drainage occurred. This is still a good trick in the right case.

Dr. William H. Snyder Jr., Los Angeles: The allied subject of diverticulitis occurring in this area has been handled in a similar fashion as that advocated by the authors. We have made a recent study of our cases of diverticulitis at the Los

Angeles County Hospital. These were found in a review of all the acute abdominal emergencies performed there. There were some 6700 cases, among which we found a series of 14 cases of acute diverticulitis. In dividing the cases of acute diverticulitis into two groups, as mentioned by Dr. Witkowski, the "hidden" variety and the obvious type, six fell into the former and eight into the latter group. In the eight cases distinguishable at surgery, excision or minor procedures were done. In the six in which the lesion could not be distinguished from carcinoma, colon resections were done in all. There was no mortality in this group. In view of this rather radical approach, we reviewed the recent literature in the last five years and were able to find 30 cases of diverticulitis of the cecum indistinguishable from carcinoma at emergency surgery, which were handled by other surgeons throughout the land by immediate colon resection. There was only one death in this reported series.

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Transpyloric Prolapse of the Gastric Mucosa

MALCOLM C. TODD, M.D., and JAMES E. BRENNAN, M.D., Long Beach, Calif.

This paper concerns one of the most interesting yet controversial anatomical variations of the pylorus, namely, a protrusion of redundant gastric mucosa into the duodenum. Since first reported by Schmieden [1] in 1911, the number of cases appearing in the literature has been rapidly increasing. The etiology is generally believed to be due to hypermotility of the gastric mucosa and a propulsion of this redundant mucosa through the pylorus during the course of normal peristaltic activity.

The accepted occurrence rate of prolapsed gastric mucosa is about 10% of all gastrointestinal examinations. Maurice Feldman [2] reported on a survey of the literature in which the incidence varied from 0.1% to 7.7%. He personally reported 371 cases of gastrointestinal studies, with 52 cases, or 14%, showing some degree of prolapse. Rappaport and Alper's paper [3] on 1000 consecutive x-ray examinations of the stomach showed 155 cases of prolapse, or 15.5%. Our studies at Seaside Memorial Hospital

TABLE 1.—*Transpyloric Prolapse of Gastric Mucosa Radiologic Diagnosis*

	Upper GI Studies	Prolapses	Per Cent
Seaside Hospital	1,220	72	5.9
St. Mary's Hospital	1,128	147	13.2
Total	2,348	219	

revealed 72 cases among 1220 upper gastrointestinal examinations. At St. Mary's Hospital 147 cases of prolapse were reported in 1128 studies. Most studies, including our own, reveal coexistent gastroduodenal pathology. Feldman also relates that duodenal ulcer was encountered in 38.5% of the cases, while 5.8% had gastric ulcer, 46% had gastritis, and 3.8% had duodenitis. The incidence of associated pathology in our St. Mary's series was 58 cases, or 39.4%. In the Seaside series, 24 of the 72 cases of prolapse, or 33%, had associated disease. We feel that this is very significant. However, in this study it seems strange that few cases diagnosed by x-ray as prolapsed gastric mucosa were followed and treated as a real entity. Yet, in practically all cases where prolapse was found, the patient was having some symptoms which led the physician to request x-ray studies.

TABLE 2.—*Transpyloric Prolapse of Gastric Mucosa*

		Cases, No.
St. Mary's Hospital		
Total		147
Prolapse—no other lesion		89
Prolapse with associated pathology		58
Duodenal ulcer	29	
Gastric ulcer	3	
Polyp	1	
Gastritis-duodenitis	25	
Seaside Hospital		
Total		72
Prolapse with associated pathology		24

Lichstein and Asher [4] state that anatomically the antral mucosa normally slides freely over its supporting layers during gastroduodenal peristaltic activity. When gastritis, ulcer, or polyp entraps the mucosa at the base of the bulb, clinical symptoms are often produced.

Patients with prolapsed gastric mucosa may complain of pain or distress in the epigastrium, cramp-like right upper quadrant pain after eating, nausea or vomiting, bloating, hyperacidity, and bleeding. These symptoms are the result of inflammation, bleeding, or obstruction at the pylorus. They may become more pronounced as the mucosa becomes more redundant.

Although we have not employed gastroscopy as a diagnostic procedure, some clini-

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cians have used this examination as a valuable adjunct in their study.

The diagnosis of transpyloric prolapse of the gastric mucosa is made by x-ray examination. Roentgenologists are not in complete accord as to the precise nature of this condition, but they do agree that, unless a prolapse is demonstrated on films, the fluoroscopic findings may be merely personal opinions. The radiologist, therefore, must be extremely cautious in making a diagnosis of this condition. Parenthetically, one must be aware of the fact that the technician may be able to simulate the condition by compression or pressure, but these findings must be constant.

From the roentgenologists' observations, most cases are found in stocky patients having steer-horn-shaped stomachs. The presence of an "umbrella" defect in the base of the duodenal bulb is important (Fig. 1). A "mushroom" appearing in the bulb, owing to hypertrophic mucosal folds protruding through the pyloric canal, assists in diag-

Fig. 1.—A pronounced protrusion of the antral mucosa into the bulb. Minimal radiating folds.

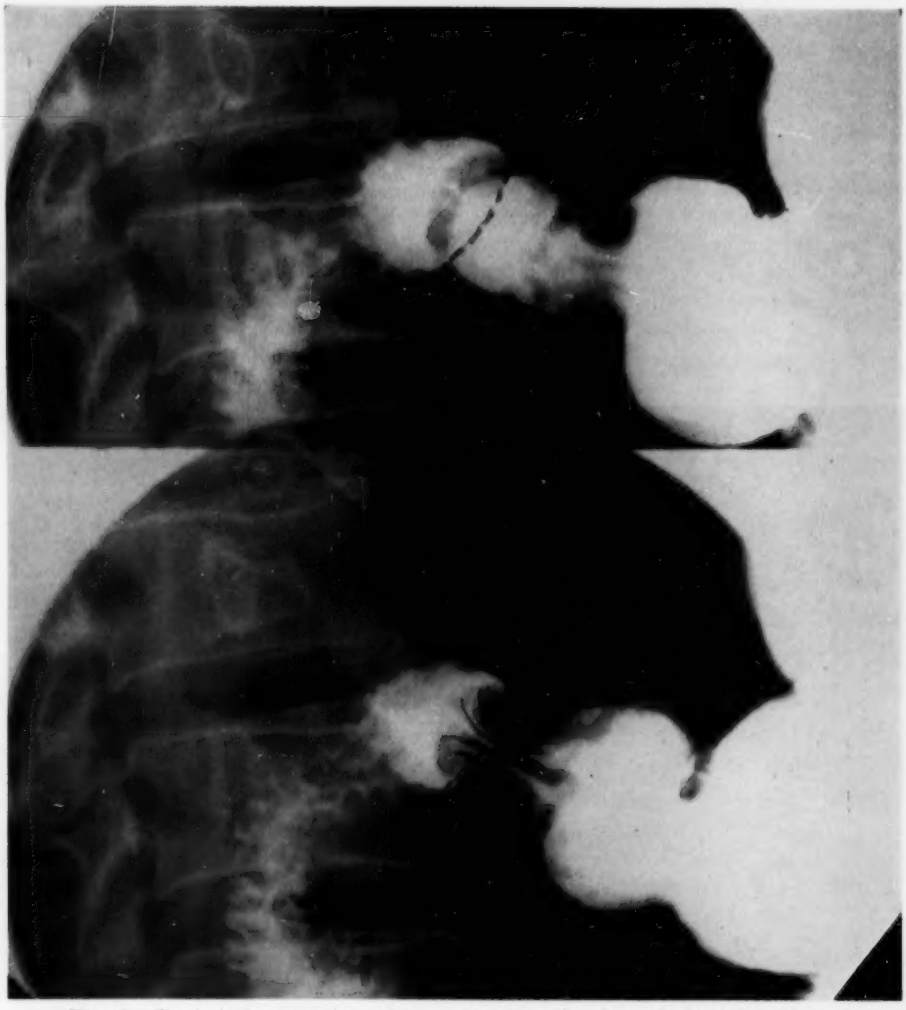


Fig. 2.—Classical demonstration with good right-angle view of the bulb. Note the "umbrella" defect and folds going through.

nosing. One other constant finding is a smooth crescent-shaped defect in the bulb, which is often associated with a widening of the canal. Finally, to be conclusive, the roentgenologist must trace the gastric rugae into the duodenal cap. In the differential diagnosis, the radiologist must consider hypertrophic gastritis, polyps, duodenal or gastric ulcer, prepyloric cancer, or antral gastritis.

Figure 2 is an x-ray demonstrating a case of prolapse with minimal symptoms and findings. The "mushroom" is present, and gastric rugae are observed. This case has been treated medically to date with success.

Figure 3 reveals a more advanced prolapse, with numerous findings and many symptoms. These findings are classical from an x-ray point of view.

In general, the treatment of transpyloric prolapse of the gastric mucosa should be conservative. Cases with intractable distress and those resistant to treatment can be relieved by surgery. Our interest in this

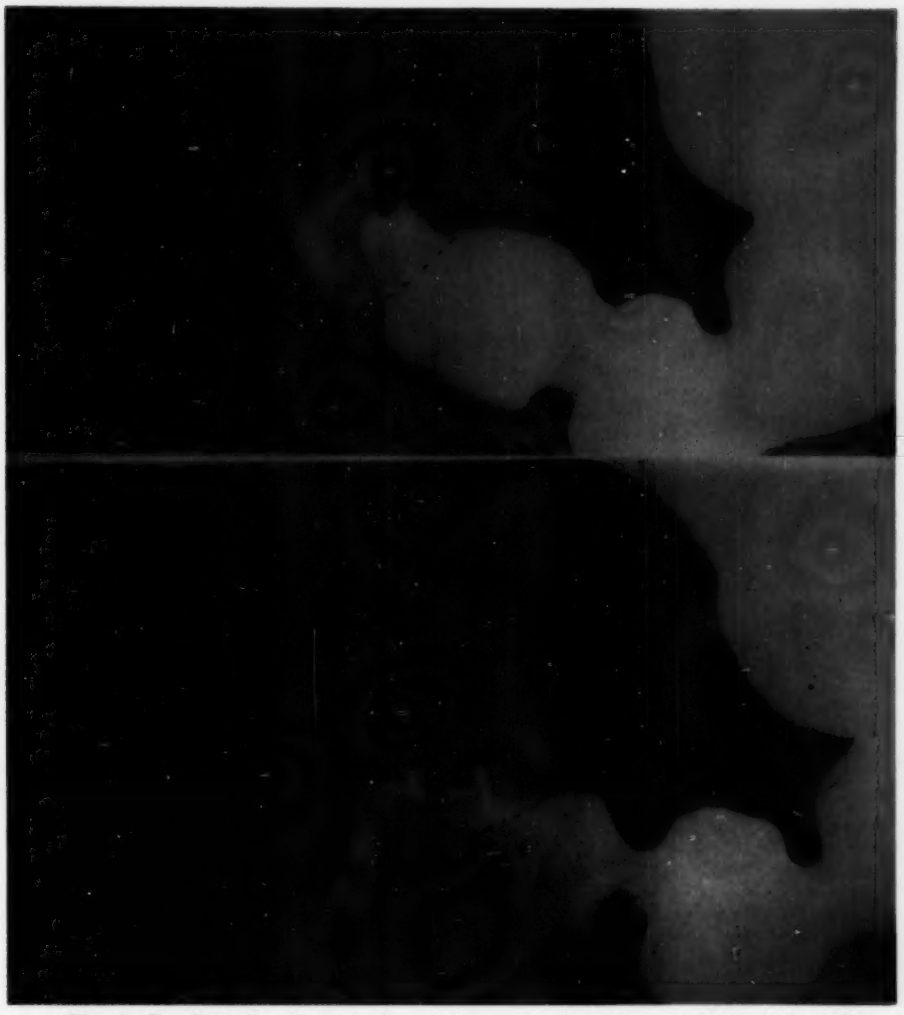


Fig. 3.—Excellent film demonstrating prolapse occupying about one-half of the bulb. Note the crescent-shaped defect.

problem has been directed toward the surgical treatment after medical management has been ineffective. We have been particularly observant of cases associated with ulcer disease. It is our feeling that if an ulcer accompanies a prolapse surgery is indicated, regardless of the presence or size of the crater or the chronicity of the lesion.

Patterson and Weintraub [5] have published an excellent, careful analysis of 133 cases. They are less conservative in their approach to this problem and believe that the indications for gastrectomy are severe pain, nausea and vomiting, hemorrhage, or the belief that the patient has an ulcer.

There are many surgical procedures recommended for prolapsed gastric mucosa. In Table 3 it is noted that, in five cases which were operated on, four different procedures were performed. C. E. Rees [6] reported on four cases treated by antral gastrotomy, excision of the redundant mucosa, and fixa-

Fig. 4.—X-rays revealing a good prolapse and a good defect.

tion of the mucosa to the muscularis. Other procedures reported are resection of the redundant mucosa and pyloroplasty, Heineke-Mikulicz pyloroplasty, gastroenterostomy and gastric resection. When surgery is indicated, we believe that it should be gastric resection or, rarely, pyloroplasty. The Billroth I type of resection is our procedure of choice. We heartily agree with Blain and Hamburger [7] that gastritis associated with prolapse makes resection a better operation than pyloroplasty.

It is our feeling that in some cases of gastrointestinal tract bleeding, where no specific bleeding point is found at exploration, the bleeding may be from prolapsed gastric mucosa. At the time of gastrostomy the prolapse is spontaneously reduced by traction and would be missed unless the surgeon has this possibility in mind. This could explain the apparent success of gastric resections in such cases.

Among our patients, one interesting case was a resection which we performed for an

TABLE 3.—*Transpyloric Prolapse of Gastric Mucosa*
Clinical Diagnosis

	Cases	Medical	Surgical	Procedure
Seaside Hospital	21	17	4	Polya Billroth I Hofmeister Pyloroplasty
1954				
St. Mary's Hospital	16	11	5	Polya Hofmeister Billroth I Pyloroplasty Hofmeister
Seaside Hospital	20	15	5	Billroth I Polya Hofmeister Polya Pyloroplasty
1955				
St. Mary's Hospital	16	12	4	Hofmeister Polya
		(All had ulcers)		Polya Hofmeister

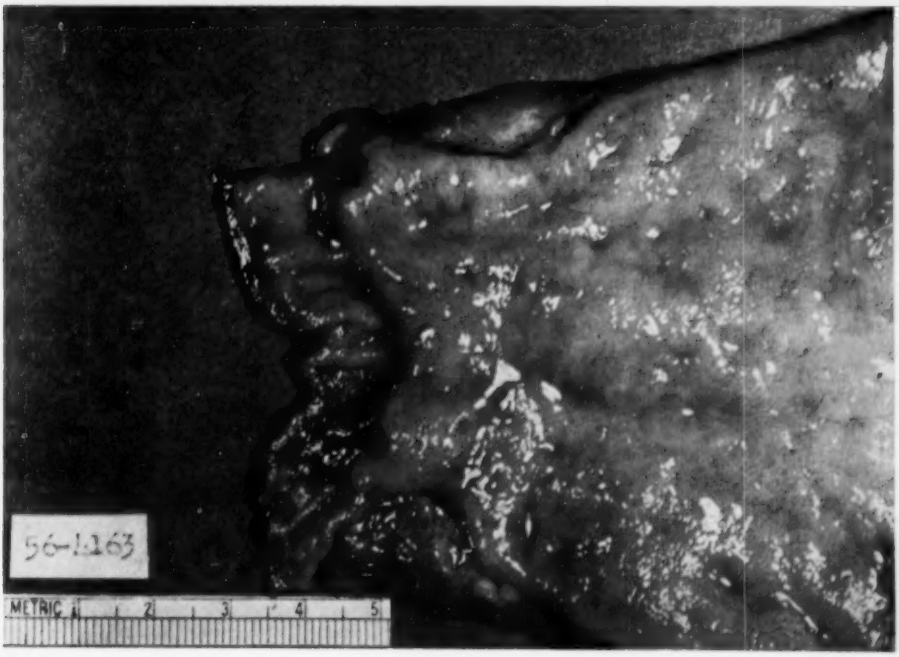
ulcer occurring in a pyloroplasty. This had been performed two years previously for prolapse. Another case was a prolapse with both duodenal and gastric ulcers. A resection was performed on this patient, and a posterior Hofmeister anastomosis was carried out. Both cases have obtained excellent clinical results.

The following case presents a classical picture in the diagnosis and management of transpyloric prolapse.

A 56-year-old white man gave a history of epigastric distress of one and one-half to two years' duration. He experienced occasional nausea and vomiting. One year previously he had been hospitalized, and x-rays revealed a prolapse. He was placed on medical treatment with corrective diet, antispasmodics, and anticholinergic drugs. Very little relief was obtained, and he was readmitted to the hospital, where urinalysis and blood studies were normal. Free and total acids were normal. X-rays (Fig. 4) showed marked prolapse without associated pathology. The patient was subjected to gastrectomy, and a Billroth I gastroduodenostomy was performed. The specimen is shown in Figure 5.

Finally, a recent case of prolapse associated with a pyloric ulcer is illustrated. Preoperatively the roentgenologist considered the negative shadow as a polyp. This case was handled by resection and a Billroth I anastomosis.

Fig. 5.—Gross specimen of stomach resected for a well-demonstrated hypertrophied mucosa and folds with prolapse.



Summary and Conclusions

Transpyloric prolapse of the gastric mucosa is a pathological condition which can produce symptoms. Although there are few characteristic clinical signs, they become more evident as the degree of prolapse increases. The final diagnosis must be dependent on x-ray. Many cases of prolapse are associated with other pathology, such as ulcer or gastritis.

Surgery is indicated when medical treatment is ineffective, when prolapse is accompanied by an ulcer, or when obstruction or bleeding exists.

Attending physicians are urged to give more consideration to this problem. They should evaluate these cases more carefully and, in turn, treat prolapse as a true pathological entity. The surgical procedure of choice in our experience is resection and a Billroth I gastroduodenostomy.

1933 Pacific Ave. (6).

DISCUSSION

DR. CONRAD JOHN BAUMGARTNER, Beverly Hills, Calif.: As Dr. Todd has so capably shown, prolapse of the gastric mucosa does not because of its mere presence necessarily produce symptoms.

The roentgenologists in three of our Los Angeles hospitals were recently questioned by me about this problem, and all three of them stated that, with the present rapid spot filming, the finding of prolapsed gastric mucosa is not an unusual occurrence, but its presence as a rule is not too significant.

I think the important questions are the following. First, is there a coexistent pathology, such as gastritis, gastric or duodenal ulcer, or actual ulceration of the mucosa itself? And secondly, is it really a prolapsed mucosa?

In relation to the latter question, I want to show some slides which will reveal the importance of knowing whether one is actually dealing with a prolapsed mucosa.

[Slide] This case was a patient of a colleague of mine, Dr. David Schmidt, who allowed me the use of these slides.

When this patient was first seen he had a history of vague so-called dyspepsia, and an excellent roentgenologist made the diagnosis of prolapsed gastric mucosa on the basis of a dark area which can be seen in the duodenum.

This patient was instructed to report back in two months. Instead, he presented himself two years later with a severe gastric hemorrhage. [Slide] The next slide, taken at that time, shows a filling defect in the duodenum. At this time the diagnosis was made of a polyp, and the patient was operated on.

[Slide] The next slide will show the operative specimen, a malignant polyp. The man had metastases, and only a palliative resection was performed. This demonstrates very definitely that even with a good x-ray one might have a mistaken diagnosis. It is rather important to know when one encounters one of these cases with a suspected prolapsed mucosa whether it really is a prolapse, and, if so, whether it is clinically significant.

DR. MALCOLM C. TODD, Long Beach, Calif.: Emphasizing Dr. Baumgartner's point, it is true that an interpretation by the roentgenologist is one that can vary. At the same time, prolapsed gastric mucosa presents a problem, such as he related, and I believe that eventually more and more of these cases will come to surgery, so that such experiences can be avoided.

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Degree of Cohesion of Cancer Cells and Its Relation to Cancer Spread

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Cancers are of two kinds, lethal and nonlethal. Many pathologists and clinical observers believe that metastasis, or the spread of a lethal cancer from a primary site to distant parts of the body by transfer of its cells through the blood or lymph channels, depends more upon the fact that the cells of such a cancer do not cohere, or because there is only a feeble cohesion, than it does upon the rapid and lawless multiplication of the malignant agents. A nonlethal cancer, such as a rodent ulcer, is spread by local extension only, because its cells cohere firmly, and it can be completely removed unless it has penetrated unremovable structures. The following history of an untreated breast cancer prompted study of the degree of cohesion of cancer cells and the effects of this cohesion on cancer spread.

A 56-year-old white woman was admitted to St. Vincent's Hospital on May 9, 1948, because of a great, cauliflower-like tumor of her right breast. Her husband, at the time of her marriage, 25 years before, had urged her to have a lump in this breast removed, but she had refused because of conscientious objection to operation. The lump had grown slowly. It had destroyed its overlying skin by 1944. It did no harm to the patient's excellent health until late in 1947, for not until December of that year had she been compelled because of weakness and shortness of breath to quit work as a demonstrator in a store.

Physical Examination.—Height, 5 ft., 4 in.; weight, 140 lb.; pale; mind clear. I discovered no abnormality of the heart or lungs, no enlargement of the liver, no masses or free fluid in the abdomen, no paralysis, and no loss of sensation. Edema was not present except in the feet and legs. Lymph nodes were palpable in the right axilla, nowhere else.

Respirations were 20 and heart beats, 100 per minute. Hemoglobin, 2.2 gm.; red cells, 1,540,000.

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Figure 1 shows the location and size of the tumor. I thought it had a weight of about 3 lb. It was fixed to the chest wall. Its surface was clean, and none of it was necrotic.

A film of the chest showed no cancer in any bone and no fluid in either pleural space. One roentgenologist stated that it showed "extensive peribronchial increase and areas of decreased aeration throughout the right lung" and believed that these findings were probably due to metastases. Two other roentgenologists, however, had the contrary belief, and, furthermore, by careful physical examination at the patient's first admission I could discover no abnormality whatsoever of this lung.

Course in Hospital.—The patient received eight transfusions (4 liters of blood) and left the hospital on June 9, 1948, in good condition, with a red cell count of 3,380,000 and 10.4 gm. of hemoglobin. She came back on Jan. 6, 1949, because of shortness of breath and generalized edema. The entire right side of her chest was then dull to percussion, lacked tactile fremitus, and was completely silent. The heart was displaced to the left, and the area of resonance due to the left lung was much reduced. The patient still had no paralysis and no loss of sensation. Her hemoglobin was 3.1 gm.

Despite blood transfusions, the patient's breathing worsened day by day, but her mind remained clear, and her pain was never great. She ate well, and she sat up on the day before her sudden death, on March 4, 1949. Autopsy was refused.

Pathologists' Findings.—Dr. H. C. Thornton, pathologist to St. Vincent's Hospital, made the following report on a piece of the tumor:

"The tissue is pink and firm. The cut surface is pink, shiny, and somewhat translucent.

"Microscopic: The stroma is very loose in texture. In most places, it has a mucoid appearance. The epithelium forms irregular masses, some of which slightly suggest acini.

"Diagnosis: Carcinoma, Grade 3 (!) of breast."

Dr. Edwin E. Pontius, who recently studied a section of this tumor, could find no cancer cells in lymph vessels and concurred in the diagnosis of mucoid cancer.

Pathologists no longer believe that mucoid cancer of the breast has a low degree of

Figure 1

malignancy.[1,14,17] The reasons for the opinion that this patient's cancer had few, if any, true metastases are as follows:

(1) Its long duration, associated with good health of its host until near her death.

(2) The absence of palpable lymph nodes in the neck. (We lack positive proof that the nodes felt in the right axilla were not cancerous, but their small size and the absence of edema of the right arm, when the cancer had been present more than 25 years, indicate that their enlargement was probably due to infection.)

(3) The absence of orange-peel appearance of the skin near the cancer and the absence also in this skin of shot-like metastases.

(4) The fact that all effects of the cancer can be explained by its direct invasion of the chest and by the great loss of blood and serum from its extensive surface. Our observations show that it did not penetrate the chest wall until late in its course and that, once inside the chest, its spread was rapid and unopposed.

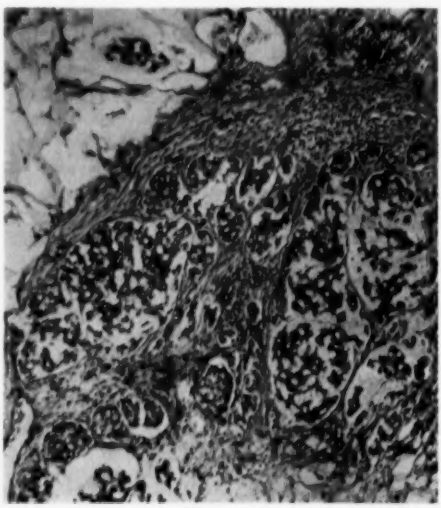

Figure 2

(5) The absence to the end of life of any signs or symptoms of metastases in the brain, bones, or abdomen.

I believe that this cancer belongs to a class of breast cancers which spread by local extension only.* The diagnosis of these cannot always be made with assurance by microscopic examination. Two competent pathologists thought this tumor was a rather malignant cancer. A breast cancer of long duration, movable, without alteration of the neighboring skin, and without discoverable metastases, is probably of this kind. When discovered, it is likely to be regarded as an innocent tumor, because it does not show the signs of early cancer. When associated with cysts, it is likely to be mistaken for one of them. Therefore, it may be present a long time before it comes to operation, but, even so, the chances of its complete removal are good. Halsted observed that the results of removing big, fungating cancers of the breast are sometimes excellent. Many other surgeons have also observed this. Nonmetastasizing cancers, like this one, have therefore not gone altogether unnoticed by clinicians. Their existence may explain the paradoxical finding that the results of late operation for breast cancer are better than those of early operation.[7-9,13,16]

Early and radical operation has not lowered the death rate of breast cancer. I wrote, in 1952, that this is because "the blood disseminates breast cancer in many and possibly in most cases."[7] McKinnon[12] contends that it is because "in most, if not all, lethal forms of breast cancer, remote spread takes place via the blood stream before interference is practicable." He contends also that high survival rates after operations for Stage I breast cancer (cancer without auxiliary metastases) do not prove the value of early operation, because this alleged proof is based on the idea that all, or nearly all, Stage I cancers would progress to lethal metastatic cancer if untreated. It is clear that not all so-called Stage I cancers are necessarily "early" or "lethal." Many of them, because of the limitations of histopathologic diagnosis, are not cancers at all. The facts compel us to accept these conclusions of McKinnon, and the conception here explored complements them.

The common notion that the chief characteristic of a cancer is a rapid multiplication of its cells is wrong.[3-4,14,18] The cells of a fetus, the cells of granulation tissue, and the cells of many benign tumors multiply as rapidly as those of any cancer, but they do not enter blood or lymph vessels or infiltrate the tissues around them; furthermore, certain slowly growing cancers, e. g., scirrhus cancer of the breast, some of them too small to be found at autopsy, may have body-wide metastases. Virchow and others after him reported seeing detached cancer cells make ameboid movements.

Delbet, according to Stout,[14] pointed out in 1927 that "when this relationship (i. e., of cancer cells to one another) is more or less closely maintained and the cells tend to cohere, the epithelial masses will be voluminous and spread and metastasis will be less rapid. On the contrary, in cancers where this coherence of cells is not well maintained, cells will be found isolated and in small groups and this is associated with widespread and more rapid metastasis."

Coman and associates have made in recent years studies of the "mutual adhesiveness" of normal and of cancer cells and conclude that a decrease of this "may constitute the physical basis for the malignancy of these cells." They believe that this decrease is due to a deficiency of calcium in metastasizing cancers.[3-6]

These citations show that the conception here considered has been held by eminent pathologists. Its truth seems self-evident, for undetachable cells cannot wander. Its implications, however, for the prognosis and treatment of cancer are not generally comprehended. I have found no papers on it written by clinicians, except numerous papers on the danger of scattering cancer by rough handling of it.

* The direct extension of a cancer is not a metastasis.[18]

The unchanging death rate of breast cancer proves that the number of lethal cancers must be nearly constant. We know this number, but we do not know the number of nonlethal growths. The latter number is probably small; otherwise, the number of 10-year survivals after operation would be greater than it is. Very few breast cancers nowadays escape operation.

The metastases of breast cancer may remain quiescent for many years.[10] This proves that the body or its constituent tissues —one or both—can sometimes and somehow restrain the growth of cancer, so that a patient may live in peace with metastases for a long time. It seems probable that a great part of this restraint is done by increasing the cohesion of the cancer cells.

I have published the observation that heavy radiation can start the spread of latent cancer.[7] There is good reason for fear that violence done the body by extremely long and radical operations may do this and also for fear that cortisone may do it.[2]

Since lethal breast cancer spreads by the blood stream before treatment is practicable, it cannot be extirpated by removal of the primary tumor and all lymphatics to which it has spread. This does not mean, however, that operations intended to remove a primary growth and its easily accessible lymphatic spread are useless, for we well know that for breast cancer they may accomplish for many patients a local cure of long duration.[10] Furthermore, the cure of a nonmetastasizing cancer demands an operation wide enough to encompass it.

Behavior Common to All Cancers

The conception that the localization or the distant spread of any cancer depends on the degree of cohesion of its cells is a logical necessity. We certainly have no reason to believe that early and radical operation has been more beneficial for cancer anywhere than it has been for cancer of the breast.

Apart from differences owing to situation in the body, all major forms of cancer behave alike. Many, perhaps all, of them have nonmetastasizing forms. The following are some examples of these which I have observed.

1. Some advanced cancers of the rectum. Patients with these may live for years in good health following sigmoidostomy. Also, some rather large, sessile cancers of the colon which do not penetrate its submucosa are cured by local removal.

2. A few cancers of the stomach. An example of these is a cancer which almost filled the stomach of a woman sent to me by Dr. J. O. Ritchey. She was living and well 15 years after a partial gastrectomy. Another patient of Dr. Ritchey's is alive and well 17 years after partial gastrectomy for polypoid cancer of the gastric antrum. I can cite other cases of the same kind.

3. Many cancers of the bladder which, even after they have extended into its musculature, are cured by transurethral removal.[15] This is a chief triumph of cancer surgery.†

4. Many cancers of the uterus which apparently are destroyed by the intrauterine application of radium.

5. Perhaps all cancers of the lung which can be cured by operation.

Summary and Conclusions

Lethal cancers, because their cells do not cohere, are spread to distant parts of the body by the blood before they can be discovered by any known method of diagnosis or extirpated by any known method of treatment. The course of many of these

† Dr. Gershom J. Thompson, who has had great experience with these tumors, writes of them as follows: "For years there has been no question in my mind that some cancers of the bladder which seem highly malignant lack the ability to metastasize. While some pathologists have a feeling that they can tell whether a growth is apt to spread widely, I sometimes wonder if they can actually do this." In a personal communication to me, Dr. Thompson says that he has seen patients live on for many years after transurethral removal of cancers which the pathologist had reported as highly malignant with invasion of the perivesical fat.

cancers, either with or without operation, is chronic, because the body can somehow restrain their growth for a long time. This is why their hosts can usually be benefited—sometimes greatly—by proper treatment.

Nonlethal cancers, like rodent ulcer and a certain number of the major forms of cancer, spread by local extension only, because their cells stick firmly together. They can be completely removed unless they have penetrated unremovable structures. The possibility that they may become lethal is always present.

The differential diagnosis of these two forms of cancer cannot always be made by microscopic examination. If metastases are present, the cancer is in the lethal class; if no metastases can be discovered, it may be in the nonlethal class, although a positive conclusion can never be proved by negative evidence. The possibility of removing metastasizing cancer by operation is not great, and extremely radical operations for its removal may do more harm than good. Nature can treat the distant metastases of a cancer better than the surgeon.

The notion that the distant spread of any cancer is due to noncohesion of its cells gives a reasonable explanation of the behavior of cancer treated and untreated. It defines the possibilities and limitations of treatment and should make this better and more rational. It explains our failure to change the death rate of any major cancer, though we seem to be curing a certain number of these. Finally, it indicates that ultraradical operations cannot extirpate lethal cancer and are unnecessary for the care of nonlethal cancer.

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Carcinoma of the Breast

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This study is based on an analysis of 787 consecutive cases of cancer of the breast registered in the Tumor Clinic at the University of Illinois Hospitals between the years 1942 and 1955. Of these, only 573 cases are reported on. The remaining 214 represented cases not operated on or those treated elsewhere and referred here in their terminal stages for advice on additional therapy. The total number, 787, was used only in computing the over-all sex incidence. Of the 573 cases, not all had sufficient data for thorough recording, such as an accurate description of the size of the tumor. Consequently, in each analysis the total number of cases used will be indicated. In computing five-year survival rates, only those cases operated on prior to July, 1950, and clinically free of disease are included in this group. All cases lost to follow-up study, or with evidence of recurrent disease, are considered dead of cancer. The 10-, 15-, and 20-year cure rates are not absolute figures, as many patients are alive and free of disease, 6, 7, 8, and 9 years postoperatively, who were not operated on long enough ago to reach the necessary 10 years to be included.

It is known that numerous such reports have been published since 1894, when Dr. Halsted first reported "Results of Operations for the Cure of Cancer of the Breast." But, because of the still hotly debated results and choices of therapy in cancer of the breast, another such analysis did not seem unwarranted. Dr. Halsted predicted, as did Lewis and Rienhoff in a later publication, that the statistical estimate of results must be constantly revised.

It is realized that, in order to speak accurately in terms of percentage, at least 100 cases should be available for study in the various categories. Percentages are freely used in this analysis, however, often with far fewer than 100 cases to base these on. In these instances trends and impressions, rather than valid conclusions, are inferred.

Initially, it is felt pertinent to point out that among the 573 cases reported on, representing 508 radical mastectomies and 65 simple mastectomies, the over-all mortality rate was 0%. This is important in that advocates of the nonsurgical or simple mastectomy plus x-ray therapy forms of definitive treatment cannot use operative mortality figures as an argument to support their beliefs.

In this series, simple mastectomy was performed for one of three primary reasons: incurable disease, advanced age of the patient, or concurrent debilitating disease.

Age

An analysis of the age incidence resulted in an almost perfect bell curve. There was only one case under the age of 20 years and only one over the age of 90 years. The peak incidence was in the age group between 50 and 59 years, and 422 of 573 cases occurred between the ages of 40 and 69 years. Under our present concept of longevity, this places the great majority of persons with the disease in an age group that could normally expect to live five or more years. Consequently, the physician's approach to this disease must be energetic and based on all the facts available to him.

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From Department of Surgery, Research and Educational Hospitals, University of Illinois, Chicago.

An analysis was then made of the five-year survivals free of disease in each decade. Prior to the age of 29 years, only 25% or less of the patients survived five years. After the age of 29 years, the five-year clinical cure rate was 45% or better for each decade. Sixty-one per cent of the patients between the ages of 60 and 69 years and 59% of the patients between the ages of 70 and 79 years were alive and well at the end of five years. These results indicate that the disease seems to be more lethal in the younger age groups. In addition, they seem to point out that the mere fact that a patient is old, chronologically, does not mean that she will not survive a significant number of years if her cancer is eradicated.

Location of Primary Tumor

Three hundred eighty-one records had accurate data concerning the location of the tumor in the breast. In the great majority (198 cases) the tumor was located in the upper outer quadrant, while only 71 cases had it located in the medial half of the breast.

A correlation of the rate of five-year survival free of disease with relation to primary location was then statistically calculated and is depicted in tabulated form in Figure 1. It would appear that lesions in the outer half of the breast have the best prognosis in general. If this is absolute fact, it is indeed fortunate that the majority of lesions are located in this area. This observation, of course, is consistent with that of Handley and is the basis for the extended operations advocated by Urban, Gardner, and others. The results of these are still to be determined. Although the so-called "superradical" mastectomy has been used in this hospital, we have an insufficient number of cases, all too recently operated on, on which to report results.

Microscopic (Pathologic) Diagnosis

All cases studied microscopically fell into three pathologic categories: intraductal carcinoma, adenocarcinoma, and carcinoma simplex. Five hundred forty-seven cases had clear-cut diagnoses. Seventy-three were intraductal carcinomas; 80 were adenocarcinomas, and 394 were classified as carcinoma simplex. There was a coexistent diagnosis of Paget's disease in 9 cases (1.6%), and 65 cases (12%) had coexistent chronic cystic mastitis.

BREAST CANCER: SURVIVAL RATE RELATED TO LOCATION OF PRIMARY LESION

Location	No. of Cases	5-Year "Cure" Rate	
		No. of Cases	Per cent
Upper Outer Quadrant	101	59	58
Upper Central	20	10	50
Upper Inner Quadrant	35	16	45
Lower Inner Quadrant	7	2	28.5
Lower Central Quadrant	7	3	42.8
Lower Outer Quadrant	19	13	68.4
Central	27	14	51.4

Figure 1

A statistical analysis of the rate of five-year survival free of disease was then made for each type of lesion. This was based on only those cases operated on prior to July, 1950, so that five-year survival rates could be computed—a total of 314 cases. Eighty-two per cent of 50 cases of intraductal carcinoma were considered cured at the end of five years, as were 75% of 56 cases of adenocarcinoma. Only 50% of 208 cases of carcinoma simplex were alive and well after five years.

Chronic Cystic Mastitis

The problem of relationship of chronic cystic mastitis to carcinoma still presents confusion. As stated above, 65 cases (12%) of carcinoma of the breast also had chronic cystic mastitis. Even more interesting, however, was the fact that nine cases were found which had had biopsies of the breast, from one to six years prior to developing frank carcinoma in the same breast—most frequently in the same geographic quadrant—which showed benign chronic cystic mastitis. One additional case had a biopsy three years prior to development of carcinoma, with a diagnosis of intraductal papillomatosis.

If nothing else, this reemphasizes that cancer can develop in patients suffering from chronic cystic mastitis and makes it mandatory that these patients be closely followed medically for the appearance of suspicious nodules.

Size of Primary Tumor

Next, an analysis was made of the effects, if any, on survival time on the basis of the clinically recorded size of the tumor. Only 167 cases had accurate statements regarding size of tumors that were operated on prior to July, 1950. No appreciable difference in cure rates was found. Fifty-seven cases had lesions measuring less than 4 cm. in diameter, with a 52% five-year cure rate. Fifty-five cases had lesions measuring 4 to 5.9 cm., with a five-year cure rate of 58%. An additional 55 cases had lesions measuring 6 cm. or more in diameter, with a five-year cure rate of 56%.

Ulcerated Lesions

Ulcerated lesions have been discussed frequently in various ways, from being a relative contraindication to surgery to representing slow-growing tumors with a reasonable prognosis. For this reason, this category was also studied. In all, there were 37 cases (7%), of which 25 cases were operated on prior to July, 1950. In this group the five-year clinical cure rate, although not the best, was good enough to consider these operable and potentially curable. Ten of the twenty-five cases (40%) were alive and clinically free of disease in five years.

Stage

Next, survival time and clinical cure rates were studied on the basis of whether or not auxiliary lymph nodes were involved. This, of course, in the cases of simple mastectomy, represents only a clinical impression and not a microscopic definition. The results are tabulated in Figures 2 and 3.

COMPARISON OF SURVIVAL RATES OF STAGE I BREAST CARCINOMAS TREATED BY RADICAL MASTECTOMY OR SIMPLE MASTECTOMY

Treatment	No. of Cases	5-Year "Cure" Rate	
		No. of Cases	Per cent
Radical Mastectomy	125	90	72.5
Simple Mastectomy	34	10	30

Figure 2

COMPARISON OF SURVIVAL RATES OF STAGE II BREAST CARCINOMAS TREATED BY RADICAL MASTECTOMY OR SIMPLE MASTECTOMY

Treatment	No. of Cases	5-Year "Cure" Rate	
		No. of Cases	Per cent
Radical Mastectomy and X-Ray Rx	157	63	40
Simple Mastectomy and X-Ray Rx	14	1	7.1

Figure 3

The apparent overwhelming superiority of radical mastectomy over simple mastectomy is not valid in this study because of the methods of selecting cases for simple mastectomy.

Biopsy

The question of the effect of various types of biopsy done more than one day prior to institution of definitive therapy was the original purpose of this study. This was prompted by an impression, based on personal experience with only a few patients, that biopsies of this sort decreased the chances of the patient's cure. Realizing this, a great effort has been made not to flavor the results of the study in this direction—as human nature is wont to do. It also seemed to be of some importance because of the increasing emphasis being placed on the gentle handling of tumors everywhere in the human body to guard against dissemination of tumor emboli. The increasing interest in aspiration biopsies seems to be in direct antithesis to the above view. Figure 4 represents the absolute statistical data obtained. It must, in all fairness, again be pointed out that percentage is used even though in each instance far fewer than 100 cases are reported. Obviously, this relatively invalidates the figures, but a trend seems apparent. It can only be hoped that these results, based on 103 cases operated on prior to July, 1950, will stimulate others to analyze their statistics in order to arrive at a fair conclusion.

Because the frequently made answer to these figures has been that aspiration and incisional biopsies were done only in far-advanced breast carcinoma, extensive summaries were made of each instance of aspiration and incisional biopsy found. These proved that the majority of the cases were actually Stage I carcinomas.

ANALYSIS OF EFFECTS OF VARIOUS TYPES OF BIOPSY PERFORMED 24 HOURS OR MORE PRIOR TO DEFINITIVE SURGERY ON SURVIVAL

Type Biopsy Preceding Radical Mastectomy	No. of Cases	5-Year "Cure" Rate	
		No. of Cases	Per cent
Aspiration	27	5	19
Incision	39	2	5
Excision	29	20	72
Simple Mastectomy	8	3	37.5

Figure 4

Sex

Of the total of 787 cases, only eight breast cancers were found in the male sex—an incidence of 1%. Of these eight cases, four were inoperable when seen and the remaining four had an average survival time of only two and seven-tenths years. One patient was alive and clinically well at the end of five years.

Onset During Pregnancy

A total of five cases were found in whom breast cancer developed during pregnancy. Even though this represents an insignificant number for statistical analysis, it is interesting to note that the average survival time for these cases was 4 years, with two cases (40%) classified as free of disease in 5 years and one (20%), in 10 years.

Onset During Lactation

Only two cases were found in which breast cancer developed during lactation. Of these, one was clinically free of disease at the end of 10 years.

Pregnancy After Definitive Therapy

Four cases were found who, sometime after being treated by radical mastectomy for breast carcinoma, became pregnant and delivered viable babies. The average survival time of these was six and seven-tenths years from the time of their mastectomy. Three of the four cases (75%) were alive and clinically free of disease in 5 years, and one (25%), in 10 years, supporting the thesis of Brooks and others that there is probably no contraindication to future pregnancies if all the cancer is believed to have been removed.

Local Recurrence

Of the 573 cases in this study, only 30 developed skin recurrence—an over-all incidence of 5.2%. This compares favorably with other series and points out the adequacy of excision in most instances, without local seeding of the field. Of these local recurrences, 27 followed radical mastectomy and 3 followed simple mastectomy.

More than One Primary Tumor

In the 573 cases reported on, 73 (12.7%) had more than one primary lesion. Three cases had three separate primary lesions, and one had four. Of these, 28 cases (4.9%) developed a second primary in the opposite breast. An analysis of the location of the additional primary malignant tumors is shown in Figure 5.

Comment

An analysis of 787 consecutive cases of cancer of the breast registered in the Tumor Clinic at the University of Illinois Hospitals between the years 1942 and 1955 is the basis for this study. The results can be discussed under four broad categories: (1) operative mortality, (2) incidence, (3) relationship of various factors to prognosis, and (4) multiplicity of origin of malignant tumors.

Mortality.—Among 573 cases operated on, representing 508 radical mastectomies and 65 simple mastectomies, there was no operative mortality. This is of extreme importance in analyzing the results of any operation designed for the treatment of cancer. If the five-year cure rate is low and the operative mortality rate is high, the rationale for the operation is difficult to define and support. If, on the other hand, the five-year cure rate is high and the operative mortality rate is low, there can be no doubts concerning the advisability of the treatment. The operative treatment of breast cancer falls into the last category, whether by simple or radical mastectomy.

The absence of an operative mortality in the cases of radical mastectomy must not, therefore, be a factor in deciding on simple mastectomy plus radiation therapy, as opposed to radical mastectomy, in the choice of therapy. This must be decided in the predicted five-year cure rates, as published by various investigators using each method,

THE DISTRIBUTION OF MULTIPLE TUMORS IN 573 CASES OF BREAST CANCER

Location	Number	Total
Opposite Breast	28	28 (4.9%)
Female Genitalia		19
Uterus and Cervix	18	
Ovary	1	
G-U Tract		3
Bladder	1	
Urethra	2	
G-I Tract		8
Cecum	1	
Transverse Colon	1	
Sigmoid	2	
Rectum	3	
Anus	1	
Thyroid Gland	3	3
Salivary Glands		2
Parotid	1	
Submaxillary	1	
Skin	12	12
Intra-Oral		2
Tonsillar Fossa	1	
Alveolar Ridge	1	
Blood		1
Leukemia	1	
Total	78	78

Figure 5

and this must be balanced against the morbidity resulting from each procedure. From the preceding figures, it would seem that radical mastectomy provides a far better promise of cure than does simple mastectomy plus radiation therapy. This, however, is invalidated by the selection of cases for simple mastectomy. A consideration of morbidity was not undertaken in this study, but Ackerman pointed out a rather high incidence of unfavorable effects in patients treated with simple mastectomy and radiation therapy by McWhirter. This problem warrants more investigation.

Incidence.—Sex: Of the total 787 cases studied, 779 breast cancers were found in

the female sex and only 8 in the male sex. This incidence of 1% in male patients agrees with the findings of Somerville and others.

Age: The peak incidence of breast carcinoma occurred in the fifth decade of life, and 422 of 573 cases reported occurred between the ages of 40 and 69 years. Because of the increasing longevity figures, these findings make the treatment of breast cancer a real problem in that the great majority (73.6%) of cases fall into an age group that would normally expect to live five or more years. We must, therefore, treat this disease vigorously with the best methods known to us, and I again point out the importance of frequent analysis of the statistical results of therapy.

Furthermore, there was a sufficient number of cases, 84 in all, in patients below the age of 40 years to make it mandatory to investigate breast tumors in this age group rather than assuring the patient that the tumor is benign.

Location of Primary Tumor: It seems fortunate that, in this series of 381 cases, the majority of tumors were found in the upper outer quadrant of the breast, as this location provided the highest cure rate, with the exception of lower outer quadrant lesions. Central and inner quadrant lesions were found to have the poorest cure rates, as has also been found by Handley and others. This is the basis for the work being done with superradical mastectomies, including the resection of the internal mammary and supraclavicular lymph nodes in continuity. The efficacy of this operation is outside the limits of this study.

Microscopic Pathology: Whereas the usual location is favorable to the patient, the cell type is unfavorable. The best cure rates were obtained in intraductal carcinomas and adenocarcinomas; yet 208 of 314 cases accurately defined microscopically as to type were of the carcinoma simplex variety.

Size: The size of the primary lesion, as measured in centimeters, at the time of surgery seemed to have little effect on survival. The relative incidences of those less than 4 cm., those 4 to 5.9 cm., and those greater than 6 cm. was nearly equal.

Relationship of Various Factors to Prognosis.—Stage: In this study Stage 1 was used to represent carcinomas clinically and/or microscopically limited to the breast, and Stage 2 was designed for those cases with clinically and/or microscopically proved auxiliary lymph-node metastases. Stage 3 and Stage 4 lesions were not reported, as they fall outside the lesions presently considered operable. In order to compute the results of therapy in Stage 1 and Stage 2 carcinomas, it is necessary to combine this analysis with the type of therapy.

Simple Mastectomy *vs.* Radical Mastectomy: An analysis of Figures 2 and 3 reveals that Stage 1 carcinomas have a much better prognosis than Stage 2, making the recently advocated philosophy of not seeing the physician early seem unwise. Although the survival rate of those treated by radical mastectomy greatly surpassed those of patients treated by simple mastectomy and postoperative radiation, the selection of poor-risk patients, or patients with far-advanced cancer, for simple mastectomy invalidates any comparison between the two in this study. The figures for radical mastectomy compare favorably with the series reported by Adair, Byrd and Conerly, Haagensen and Stout, Harrington, Shimken, and others.

Location of Primary Tumor: As discussed above under the incidence factors, the majority of lesions were located in the upper outer quadrant, which provided the best prognosis.

Microscopic Diagnosis: Carcinoma simplex carried with it the poorest prognosis but the highest incidence. This, too, was discussed under the broad category of incidence.

Ulcerated Lesions: Haagensen and Stout and others have indicated that ulcerated lesions are a relative contraindication to radical mastectomy. This study, although representing a statistically inadequate number, did not indicate that ulceration carried

a hopeless prognosis. On the contrary, the average survival time was 5.2 years, and 40% were found to represent clinical cures in 5 years, and 8% in 15 years.

Biopsy: The question of whether biopsy done one day to several weeks prior to definitive therapy affects the prognosis is an interesting one which has recently received enthusiastic discussion both pro and con. In order to study this, all cases having had biopsy (aspiration, incisional, excisional, or simple mastectomy) were considered. In order to avoid the inevitable objection that aspiration and incisional biopsies are usually performed in far-advanced cases, each of these cases was analyzed as to stage, and the majority were found to be Stage 1.

Incisional biopsy proved to be lethal, reducing the average survival time to two and one-tenth years, with only a 5% five-year clinical cure rate in the 39 cases found. Twenty-one of these were Stage 1 lesions. This is in direct antithesis to the advice of Riddell.

Aspiration biopsy, done in 26 cases, 11 of which were Stage 1, reduced the average survival rate to three and one-tenth years, with a five-year survival free of disease of only 19%. This would seem to oppose the views of Robbins and others, who claim that aspiration biopsy is a perfectly safe procedure with regard to ultimate prognosis.

Excisional biopsy, on the other hand, seemed to have very little effect on prognosis in the 29 cases found. These had an average survival time of six and nine-tenths years, with a five-year clinical cure rate of 72%.

Since according to Dr. Orndorff there have been recent trends toward performing simple mastectomy for biopsy purposes, it was felt pertinent to record the eight cases found representing this form of biopsy. It is agreed this is an entirely inadequate number of cases from which to draw any conclusions, but the results are presented for use by others in compiling adequate figures. The average survival rate in this group was five and three-tenths years, with a five-year clinical cure rate of 37.5%.

These figures suggest that biopsy of breast lesions a day or more prior to definitive surgery appreciably shortens the life expectancy of the patient as well as lowering the five-year clinical cure rates. It would therefore seem that the continued use of aspiration biopsy, as might be performed in the office or the clinic, should be abandoned.

All data point to the fact that carcinoma is still a vicious and lethal disease which must be attacked vigorously but gently. It would seem that any undue manipulation or surgical trauma of cancer is hazardous and likely to disseminate a lesion still curable in different circumstances.

Pregnancy: Five cases were found to have developed a breast cancer during pregnancy. The average survival rate of 4 years, with a 40% 5-year clinical cure rate and a 20% 10-year clinical cure rate, seems to indicate that pregnancy per se does not make the outlook hopeless if the lesion is early and adequately treated.

Following treatment by radical mastectomy, four cases were found who became pregnant one or more times. In these the average survival time after surgery was six and seven-tenths years. There was a 75% 5-year clinical cure rate and a 25% 10-year clinical cure rate.

Lactation: Two cases were found to have developed breast cancer during lactation. Of these, one was considered clinically cured at the end of 10 years.

Chronic Cystic Mastitis: The question as to whether or not chronic cystic mastitis is a precancerous lesion is considered in this presentation. Sixty-five of 547 cases (12%) of breast carcinoma had concurrent chronic cystic mastitis. This reemphasizes the fact that cancer can develop in patients with chronic cystic mastitis.

Heller and associates, in 1955, analyzed the data accumulated by the National Cancer Institute and reconstructed the broad pattern of cancer incidence. A survey of their figures revealed that in the over-all population, including both sexes and the whites and nonwhites, 1 in 1500 persons (0.07%) develops

breast cancer yearly. This compares closely with the expected annual attack rate of 0.058 per 100, reported by Warren, and the probable incidence of cancer of the breast in white women between the ages of 35 and 50 years has been reported by Dublin of the Metropolitan Life Insurance Company as 0.114 per 100.

In 13 years at these hospitals (1942 through 1954), tissue was removed from 251 patients for biopsy of lumps in their breast, with a final diagnosis of chronic cystic mastitis. As mentioned above, nine of these eventually developed carcinoma in the same breast. Stated differently, 1 in 28 (3.6%) on whom biopsies were done for chronic cystic mastitis developed cancer in the same breast one to six years later. This is the exact percentage figure reported by Guy's Hospital in London in 1955.

Warren has stated that the cancer rate for women with preexisting breast lesions is four and one-half times as great as for all women. He claims that 1 woman of every 29, after biopsy of her breast for cystic mastitis, develops cancer. This is nearly the same figure arrived at in this series.

In this study, the cases on whom a biopsy had been performed for chronic cystic mastitis and who later developed cancer fell between the ages of 35 and 69 years, the highest incidence being found in the postmenopausal group.

This does not imply that chronic cystic mastitis per se is a precancerous lesion, as it is well known that a high percentage of women have chronic cystic mastitis in some form. Most of these cases represent a diffuse, finely nodular process. It does seem significant, however, that these cases of chronic cystic mastitis, presenting with a dominant lump considered to require biopsy, have greater than four times the chance of developing carcinoma than the average population.

Multiplicity of Origin of Malignant Tumors.—Slaughter, Bugher, and others have pointed out that patients who have cancer in one breast are more likely to develop malignancy in the opposite breast than those who have never had a cancer. Of 573 cases of breast cancer in this series, 73 (12.7%) were found to have developed one or more new primary lesions. Of these lesions, 28 (4.9%) occurred in the remaining breast. This is a great deal more than the expected rate of occurrence based on chance, reported variously as between 0.5% and 1%. Statistically, this compares with the findings of Kilgore, who concluded that a woman who has had one breast cancer is from three to four times as likely to develop one in the other breast as is a normal woman to have one breast cancer. It is for this reason that prophylactic simple mastectomy has been advised by some for the opposite breast at the time of radical mastectomy.

The importance of this to the average physician examining a postoperative cancer patient is that he must always consider the possibility of second primaries in other organs and must not limit his examination to the site already treated.

Summary and Conclusions

Radical mastectomy is a reasonable form of therapy for breast carcinoma because of its low operative mortality rate and respectable five-year cure rate.

The cure rate in Stage 1 carcinomas of the breast is much higher than in Stage 2 lesions. This means that the sooner the patient is permitted definitive therapy the better her chances are of being cured.

It appears that the disease is more difficult to control in younger age groups.

The observation of Handley, Urban, and others that inner quadrant lesions have a poorer prognosis than outer quadrant lesions is substantiated in this study.

Ulcerated lesions have a respectable cancer cure rate and should not be considered relative contraindications to performance of radical mastectomy.

Chronic cystic mastitis, presenting with a dominant lump considered to require biopsy, must be considered as a potentially malignant condition.

Aspiration and incisional breast biopsies done 24 hours or more prior to definitive surgery greatly shorten the life expectancy and decrease the five-year cure rate of the patient.

In the case of any breast mass worthy of biopsy the procedure should be done in the operating room with use of general anesthesia. If the frozen section proves to be carcinoma, immediate radical mastectomy should be done.

Persons with one cancer are prone to develop another primary lesion. Follow-up studies should, therefore, not be limited to the previously area operated on but should include a complete interrogation and physical examination.

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DISCUSSION

ON PAPERS BY DR. GATCH AND BY DR. DAVIS

DR. GERSHOM J. THOMPSON, Rochester, Minn.: Pathologists have speculated for years about the nature and mechanism of the spread of cancer cells. Many theories have been advanced, some of which seem rather plausible. Experiments involving the shaking of tissue fragments in flasks have demonstrated that the cells of normal tissue

resist being shaken apart, that comparatively benign tumors have less cohesion, and that high-grade tumors have very little cohesion of cells, so that they fragment easily into individual cells or small components of a few cells. It requires very little additional imagination involving potential ameboid activity of cancer cells and the theoretical production in tumors of spreading enzymes, such as hyaluronidase, to easily explain the mechanics of metastasis. Several pathologists with whom I have discussed this subject have taken a dim view of these theories; they think that the real explanation of metastasizing potential has not yet been discovered. Broders' method of the grading of neoplasms, based on alteration of the nucleocytoplasmic ratio, the increased chromatin content of the nucleus, and the variation in cell size and arrangement, has established an index for prognosis of great value. Yet, is it true that the method is not infallible? Some high-grade tumors will not metastasize, or at least clinical evidence of it cannot be found.

One of our pathologists, Dr. Robertson, used to speak of favorable and unfavorable soil as a factor in the effect of cancer in any person. He felt that many cancer cells which had spread from the primary growth died before they could establish a foothold in the particular tissue where they lodged. The soil was not favorable, and it resisted this seedling. Numerous articles have appeared describing the resolution of metastatic nodules in the lungs and in other organs after the extirpation of a primary growth. Undoubtedly this happens far more frequently than we think it does. Apparently the soil of the host, perhaps all the cells in the body change in some way once the large primary tumor is excised. Possibly this is due to some as yet unrecognized chemical alteration in the body, which has developed in resistance to the cancer and which is effective when the largest part of the invading growth is removed.

Further speculation here would be wasteful of time. Clinically, I have seen a number of cases which have substantiated Dr. Gatch's views. In several instances I have removed a high-grade cancer from the urinary bladder when it had already extended into the perivesical area, and yet, on subsequent examinations extending for five years or more, I have been unable to find signs of recurrence either locally or peripherally.

Beyond any doubt, some patients have greater tissue resistance to the particular cancer which afflicts them than do others who have an identical growth as measured cytologically. Clinical experience bears this out. It is also true that the sex of the patient is an important consideration. Vesical neoplasms afflict four times as many men as women, and the five-year cure rate in women is 52% as compared with 26% in men, based on my experience in 300 cases of high-grade neoplasm.

I think, therefore, that Dr. Gatch's plea for careful clinical assessment of the cancer case is an excellent idea. We must not be discouraged too much by the preliminary biopsy findings. The long duration of the history often is a clue to unusual individual cancer resistance which may be important to the patient's recovery after surgery. It is not necessarily true that a long history and a large tumor mean a bad prognosis. In fact, the results of treatment are often good in such cases and poor, in contrast, in those wherein the tumor is discovered early while it is still small. Much remains to be learned about the whole subject.

DR. WARREN H. COLE, Chicago: I should like to confine my remarks to Dr. Davis' paper, since I am more acquainted with that. Dr. Davis brought out several very important points in his paper, and most of them, I think, are not fully appreciated by surgeons. I am referring particularly to the five-year survival rates following various types of biopsy.

I have been worried for years about the damage we might do in the way of spread of the cancer, by biopsies not well planned.

You recall that when aspiration biopsy was done more than a day or so before operation the five-year survival rate was only 19%, and only 5% when the biopsy was of the incisional type. Although that series is small, I think those figures are sufficiently striking to make us worry about results when biopsies of that type are done days before operation. At least we have some solace in the fact that the five-year survival rate in patients having excisional biopsy before operation was 72%.

In general, I believe we are doing too many biopsies of the breast and should rely much more on our clinical impression and do the radical resection without the danger of biopsy in every case. In fact, several of us were talking about this subject last night, and one of our group, I think it was Dr. Taylor, remarked that he was about ready to give up biopsies in more than half of these cases.

I think another important point in Dr. Davis' report is the relationship of chronic cystic mastitis to cancer of the breast. His figure of development of carcinoma in 3.5% of patients with chronic cystic mastitis coincides so closely with Atkins' and Shield Warren's that I think it is significant, and it supports my worry about the danger of development of carcinoma in chronic cystic mastitis.

Let me remind you of a precaution in preparation of patients in the operating room preceding operation. Please do not allow your residents or

nurses to use soap-and-water technique on nodules of the breast. The breast must not be scrubbed with soap and water, because of the danger of massaging tumor cells into distant lymphatics and veins. You can obtain adequate asepsis by painting the breast with one of the more effective antiseptics.

DR. RALEIGH R. WHITE, Temple, Texas: I wish to congratulate Dr. Davis and Dr. Cole for their excellent study of breast cancer. Their record of 573 mastectomies without mortality is superb and enviable.

At the Scott and White Clinic we have had a particular interest in breast carcinoma for a number of years. You recall that in 1916 Dr. A. C. Scott Sr. pioneered the use of actual cautery instead of the cold knife in radical mastectomy to prevent seeding of the incision with cancer cells.

Dr. Davis and his sponsor have suggested the relationship of chronic cystic mastitis and subsequent cancer of the breast in that 3.6% of their patients with confirmed mastitis developed carcinoma in from one to six years. The relationship of the two diseases would be even more alarming should this incidence of 3.6% of cancer show a significant increase with the passage of longer intervals of time.

[Slide] To determine this point, I have followed for 10 to 25 years a series of 186 patients with chronic cystic mastitis confirmed by biopsy. The average follow-up period was 19.9 years. Eight of these patients, or 4.3%, eventually developed cancer of the breast. This incidence of carcinoma after prolonged follow-up confirms our opinion that women with chronic mastitis must be followed very carefully at regular intervals because of the danger of carcinoma. However, in my opinion, it also offers reassurance that we are justified in not advising prophylactic mastectomy for mastitis.

The last question I would like to discuss is that of benign papilloma and papillary adenocarcinoma of the breast. These intraductal papillomas tend to be of multicentric origin, may be scattered throughout the breast, and not infrequently are bilateral. While microscopically they appear to be benign, they can and will metastasize upon occasion to axillary lymph nodes. In my experience, if the pathologist will search diligently he often will find papillary adenocarcinoma associated with these so-called benign papillomas.

We have, of course, as many of you have, patients with benign papilloma treated by segmental resection, and the results apparently are good. It has been disappointing to note, however, that, when the patients having segmental resection or local excision were followed for five years, more than 11% had to have additional surgery upon the breast. All these patients must be observed very carefully, and we cannot but be apprehensive concerning the future development of adenocarcinoma.

[Slide] Here is a photomicrograph of what appears to be a benign papilloma of the breast. Additional study of the breast tissue revealed a low-grade duct-cell carcinoma, and a radical mastectomy with resection of axillary lymph nodes was performed. The interesting and important point was that here in an axillary node we found metastasis which again resembled a so-called benign papilloma but which had proved its malignant potential by metastasizing to an axillary node.

This and other experiences have led us to believe that at the present time it may be a safer policy to advise a simple mastectomy with axillary lymph node dissection in continuity for most instances of intraductal papilloma. If the axillary nodes are positive for metastasis, then, of course, the operation is completed as a radical mastectomy. Should the process be extensive, removal of the remaining breast must be considered, as, owing to the bilateral nature of the disease, occult cancer has been found in the opposite breast on more than one occasion.

In summary, I cannot but believe that so-called benign papilloma and papillary adenocarcinoma are closely related, if not stages of the same pathological entity, and benign papilloma must be treated carefully with this possibility in mind.

Abdominoperineal Resection Morbidity

Preoperative and Operative Factors

JOSEPH A. BUCKWALTER, M.D., Iowa City

Complications and mortalities observed in 176 patients undergoing abdominoperineal resection at the University of Iowa Hospitals from 1947 through 1951, inclusive, were reported and discussed in an earlier communication.[1] This was the total number of abdominoperineal resections performed at the University Hospitals during this five-year period for all indications by all surgeons. The diagnosis, sex, and ages of these patients are recorded in the Table. One hundred eleven patients had one or more complications, for a total of 206 complications. Seventy-eight patients had early nonurologic complications; thirty-four, early urologic, and thirty-two, late complications. There were 17 * deaths (9.6%).

The present report is concerned with an evaluation of the possible causative roles played by certain preoperative and operative factors in the genesis of the observed morbidities. The days' duration of the postoperative hospitalization (POD), incidence of complications (CI), and mortality rate (MR) have been used as indices of morbidity. The mean postoperative stay was 21.9 days; it was 26.5 for patients developing early complications and 15.7 days for the 65 patients who had none. Since patients with ulcerative colitis had a substantially shorter postoperative stay (15.2 days) than those with other diagnoses, they were not included in these calculations or in later calculations concerned with postoperative hospitalization (POD). The day of death was used in determining the POD of patients dying during the period of postoperative hospitalization. The absence or presence of complications (CI), in general, was the most important factor determining the duration of the postoperative hospitalization. However, more subtle features of the postoperative period, not recorded as complications, did contribute to the morbidity and are reflected in the duration of the postoperative hospitalization (POD). Mortality rate (MR) provides a third morbidity index, which would seem a less sensitive method of assessing postoperative morbidity than the duration of postoperative hospitalization (POD) or the incidence of complications (CI), because of the small number of patients dying.

It is believed that these studies, by emphasizing the usefulness of certain preop-

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Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

* Table IV[1] is incorrect; instead of 8, there were 9 massive pulmonary embolism deaths, giving a total of 17 mortalities.

Patients Undergoing Abdominoperineal Resection, 1947 Through 1951

Lesions	Patients, No.			Age	
	Male	Female	Total	Range	Mean
Adenocarcinoma	84	52	136	18–84	65.8
Epidermoid carcinoma	5	5	10	46–70	58.5
Ulcerative colitis	5	11	16	18–59	36.5
Polyposis	1	3	4	20–41	32.5
Precancerous polyp	1	2	3	52–68	60.5
Others	0	7	7	50–66	59.5
Total	96	80	176	18–84	62.0

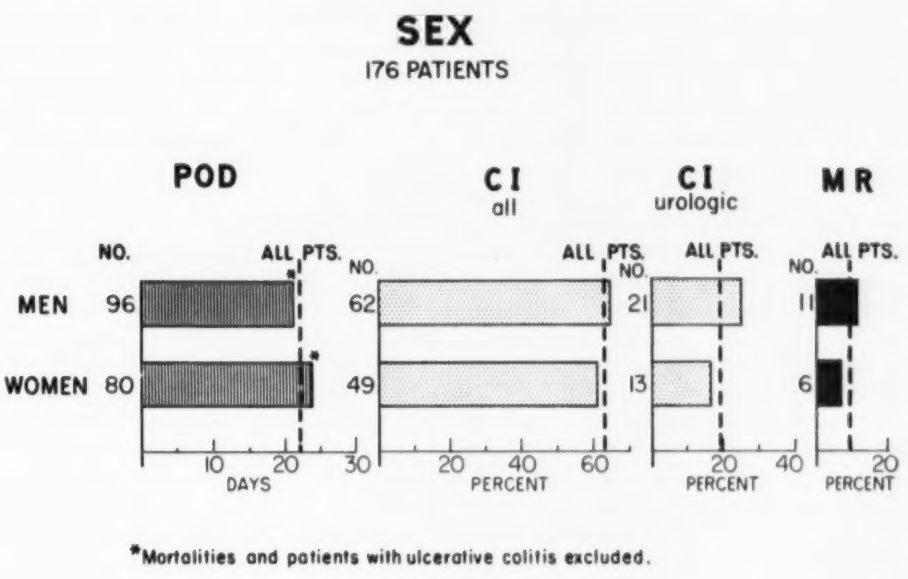

Figure 1

erative criteria in evaluating operative risk, in preparing the patient for operation, and by calling attention to the importance of technical details frequently neglected, will lead to a lowered morbidity and mortality. It is also to be hoped that these discussions may prove provocative of new ideas, in turn contributing to a lowered morbidity and mortality. Lastly, these data will provide a base line useful in assessing the merits of subsequent technical innovations in the performance of abdominoperineal resection, particularly at the University of Iowa Hospitals.

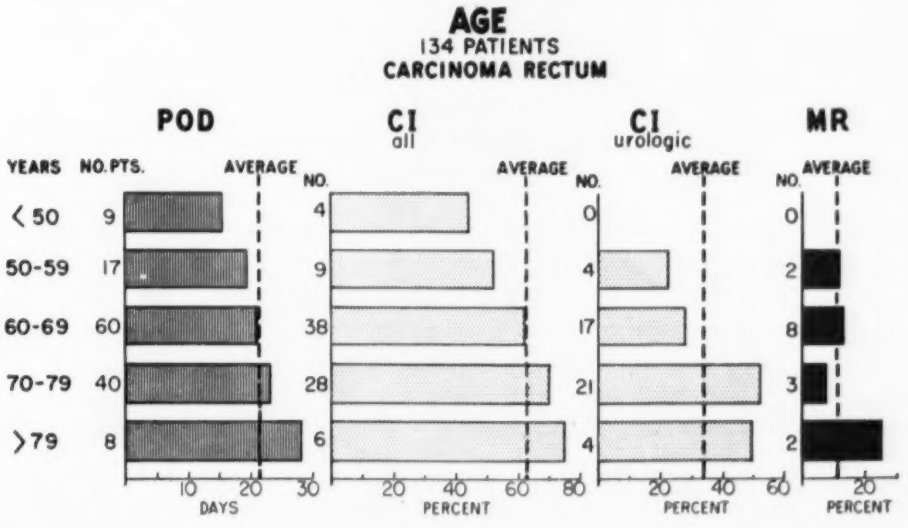

Figure 2

Preoperative Factors

The incidence of urinary complications (CI-urologic) and mortality rate (MR) were conspicuously lower in women (Fig. 1). A lower morbidity and mortality in women than in men might be expected because of the larger pelvis, making exposure of the lesion easier and better, thereby facilitating the operation. The interposed uterus decreases the likelihood of urinary tract involvement by rectal lesions and damage to the urethra, bladder, and ureters, incident to the operative procedure. On the other hand, note the higher POD and CI (if urologic complications are excluded) observed in women. Although the differences in question are far from convincing, they do suggest the possibility that women may be more prone to develop complications other than those of the urinary tract, thereby explaining the longer time in the hospital after the operation.

In Figure 2 are the data obtained from the 134 patients with carcinoma of the rectum. An association of age with morbidity is suggested by the increased postoperative hospitalization time (POD) and increased incidence of all complications (CI-all), apparently associated with increasing age. Note that the increase in the incidence of all complications (CI-all) reflects not merely the increase in urologic complications (CI-urologic) but an increase in all kinds of complications. The data are insufficient to permit conclusions to be drawn regarding mortality. A detailed discussion concerning age as a factor in morbidity and mortality has been published.[2]

Information was available concerning preoperative loss in weight for 133 patients (Fig. 3). The longer period of postoperative hospitalization required for patients with >20 lb. weight loss is of dubious significance. Differences of much greater magnitude are observed in the other two indices, CI and MR, suggesting increased morbidity proportional to the amount of preoperative weight loss.

Skepticism exists regarding the value of plasma protein determinations in the preoperative evaluation of such patients. Study of the data recorded in Figure 4 shows an increased incidence of complications (CI) and a higher mortality (MR) in those patients with lowered plasma protein values. Most interesting is the comparison of the morbidity indices of those patients with >6.5 gm.* of plasma protein per 100 ml. of

* In figure 4 6.6 in the last three figures in the first column should be 6.5.

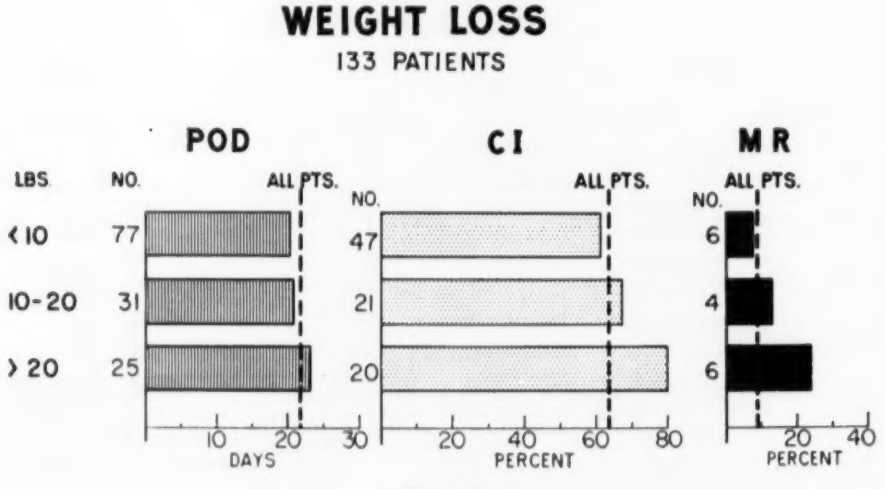

Figure 3

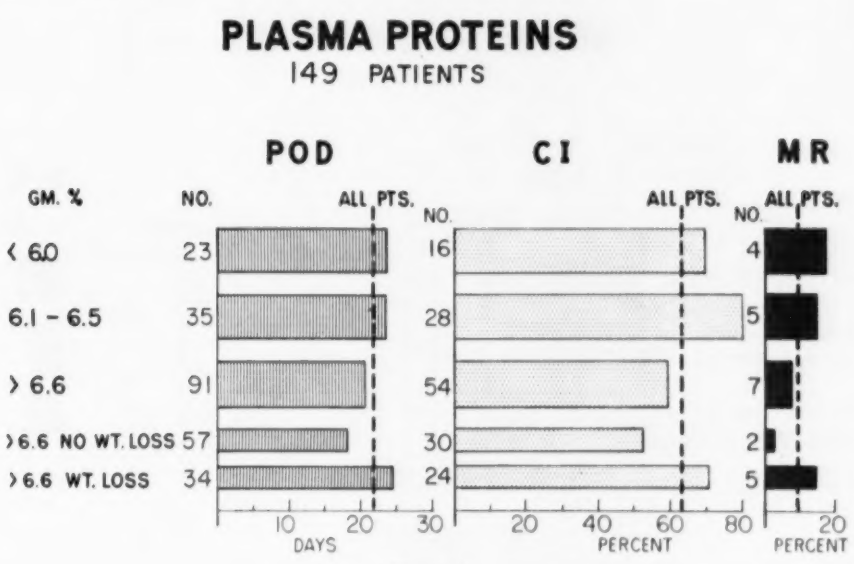

Figure 4

whole blood, who had >10 lb. preoperative weight loss, with those of patients with similar plasma protein levels and no weight loss. Undoubtedly, the plasma protein values in the former were falsely high, reflecting a depleted blood volume. Plasma protein levels were obtained at the time of admission, before correction of the lowered blood volume.

Anemia and/or depleted blood volume in 31 patients were corrected by giving 500 ml. or more of whole blood during the preoperative period (Fig. 5). Note the marked increase in POD, CI, and MR in the group receiving transfusions. These findings are most pronounced in 26 patients receiving transfusions and having 10 lb. or more weight loss, who most probably had the lowest blood volumes.

In Figure 6 are recorded the data concerning preoperative preparation of the bowel. In all patients the colon was mechanically cleansed, as permitted by the lesion, with the use of saline catheratics and enemas. Succinylsulfathiazole (Sulfasuxidine) was administered for five preoperative

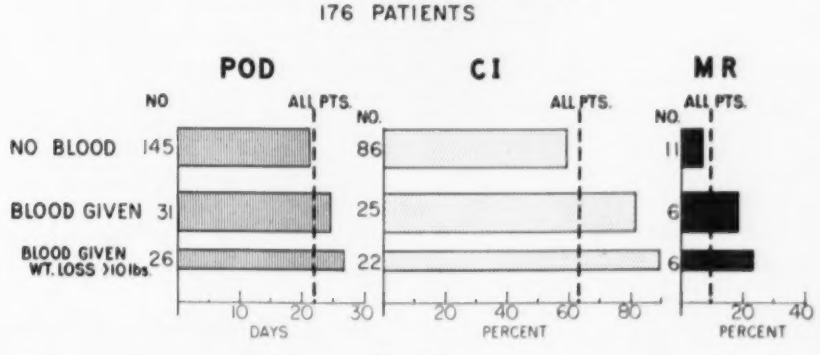

Figure 5

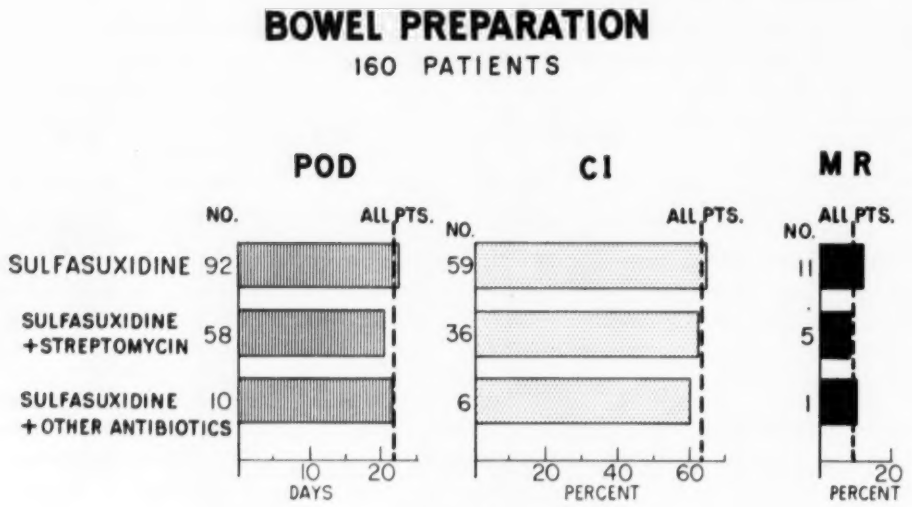

Figure 6

days, 2.0 gm. every four hours. When used, dihydrostreptomycin was given as 0.5 gm. every six hours for two days prior to operation. The other antibiotics employed included penicillin, chlortetracycline (aureomycin), and neomycin. There would appear to be no difference in postoperative morbidity between patients given succinylsulfathiazole or succinylsulfathiozole and streptomycin and the small group receiving succinylsulfathiazole and other antibiotics.

Operative Factors

Nitrous oxide, supplemented with barbiturates, meperidine, and muscle relaxants, was the primary anesthetic agent in 122 cases. Comparison of this group of patients and those anesthetized by other methods (cyclopropane, ether and ethylene inhalation, and spinal and caudal anesthesia) failed to reveal any differences in the morbidity indices, suggesting an association between the method of anesthesia used and postoperative morbidity. Similarily, there appeared to be no relationship to complications, such as shock, occurring during the operation.

Figure 7

The three types of abdominal incisions used are shown in Figure 7. In general, incisions were closed in layers with the use of either nonabsorbable surgical suture U. S. P. (silk) or stainless-steel wire. The data recorded in Figure 8 suggest no relationship of the type of wound to postoperative hospitalization (POD) or wound complications (evisceration [2], separation [5], and infection [20]) except for the strikingly low incidence of the last with midline wounds. Note that in only 2 (5.8%) midline wounds, compared with 41 (77.4%) left paramedian and 50 (56.8%) transverse wounds, was the colostomy brought out through the wound.

The end of the remaining colon was brought out either through the incision or

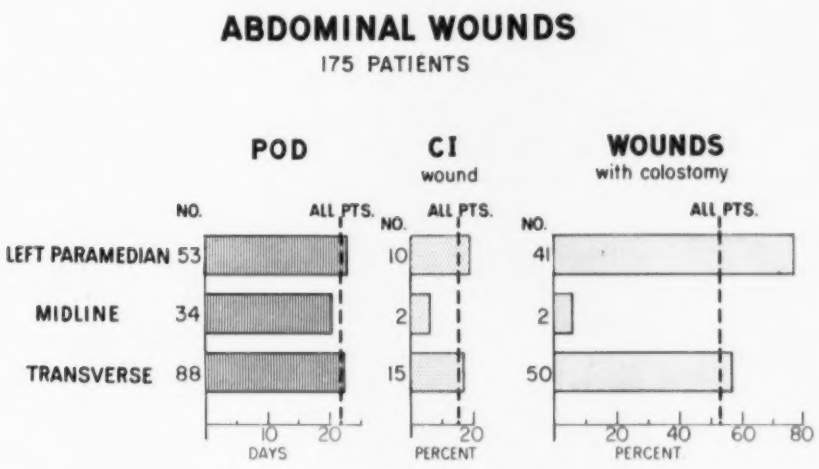

Figure 8

through a separate wound in the left lower abdominal quadrant. A clamp was left in place on the colon for 24 to 48 hours, or the end of the colon was sutured to the skin or subcutaneous tissues with interrupted sutures of fine absorbable surgical suture U. S.P. Closing the left colic gutter by suturing the edge of the mesocolon to the parietal peri-

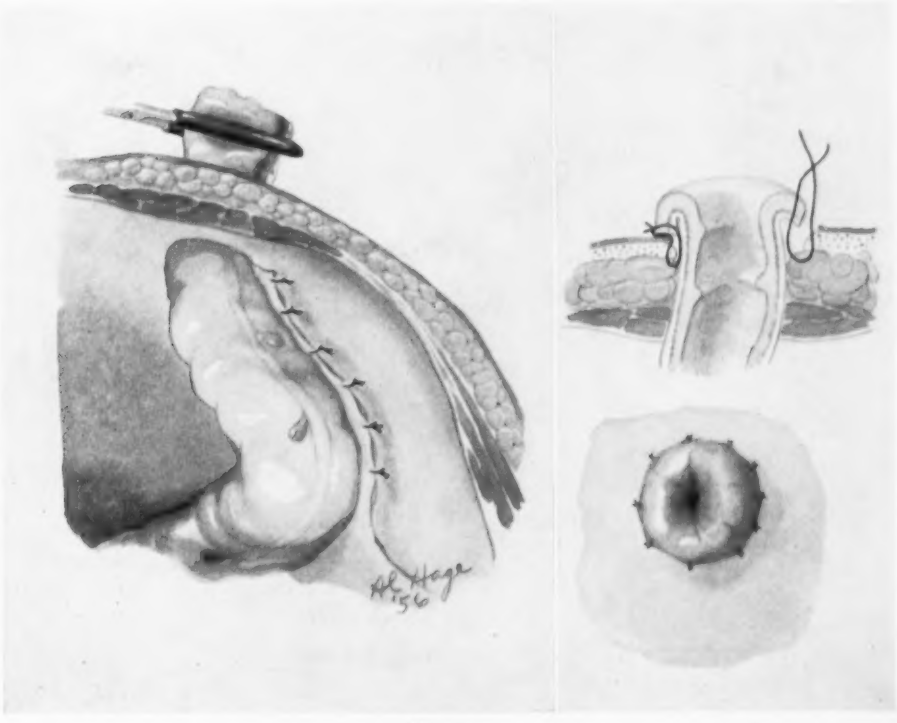

Figure 9

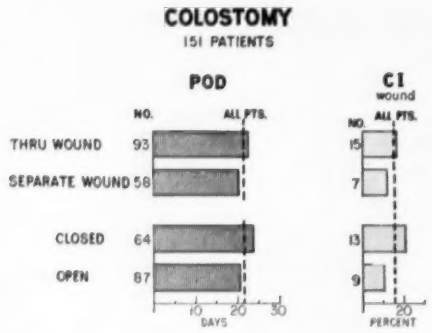

Figure 10

toneum prevents herniation of small bowel through the space between the colon and the lateral abdominal wall. In two patients, when the gutter was not closed, such herniation occurred, resulting in strangulation, gangrene, perforation, and death in one. These points of technique are illustrated by drawings (Fig. 9). Observe that the period of postoperative hospitalization (POD) was shorter and the incidence of wound infections (CI-wound) markedly lower in patients who (1) had the colon brought out through a separate wound and (2) had an open-sutured colostomy (Fig. 10). Evaluation of the meaning of these observations is complicated by the fact that both factors, i. e., position and type of colostomy, were acting simultaneously.

All 176 operations were done by a single operator, the "two-team" approach being instituted in 1952. At the end of the abdominal part of the operation, the patient was placed in the lithotomy position and the operation completed with excision of the anus and removal of the resected specimen. Shock (hypotension, rapid pulse, etc.) developed at this juncture in 15, or 10.3%, of 146 patients placed in the lithotomy position, and 2, or 6.7%, of 30 patients placed in the Sims position.

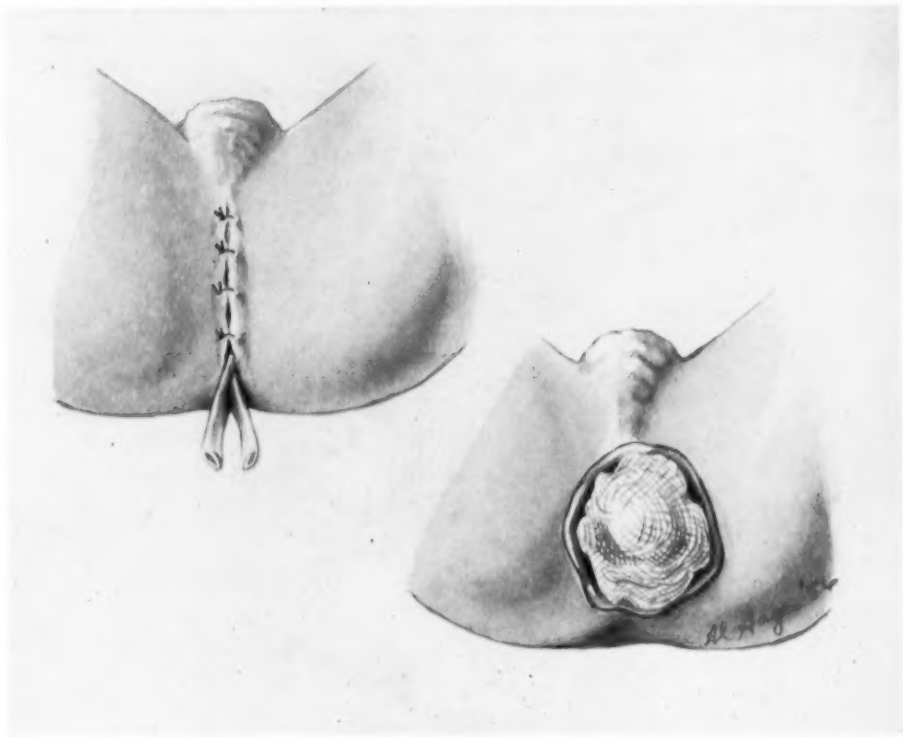

Figure 11

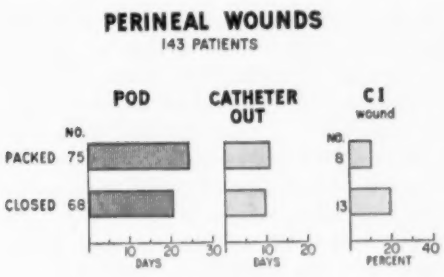

Figure 12

The two methods used in dealing with the perineal wound are shown in Figure 11. Closure of the perineal wound was accomplished with use of a few interrupted absorbable surgical sutures in the subcutaneous tissues and a minimal number of interrupted stainless-steel or silk sutures in the skin. One or more soft rubber drains, extending to the hollow of the sacrum, were placed posteriorly. The wounds left open were packed with gauze enclosed in rubber sheeting or gloves. In comparing the two methods of perineal wound management, the POD, the day when the Foley catheter was finally removed, and the incidence of perineal wound complications (CI-wound) were determined (Fig. 12). Perhaps the most important cause of postoperative urinary retention is disturbance of the normal anatomy in the area of the internal urethral sphincter and the bladder neck, which frequently accompanies this procedure.[1] The findings suggest no difference in the incidence of postoperative urinary retention in these two groups of patients. Abscess or hematoma formation, requiring reopening or drainage, and late persistence of chronic infection with drainage were the perineal wound complications observed. Two urethral fistulae were noted, but since these were caused by damage to the urethra during the operation, they are not included. In evaluating these findings, the factors which determined the management of the perineal wound must be kept in mind. In some cases, the surgeon's impression concerning which method is attended by the lowest complication rate and the shortest healing time was the only determining factor. However, insecure hemostasis or contamination incident to the resection of large low-lying lesions was accepted as indication for packing the perineal wound. Thus, in general, the wounds closed were more frequently smaller, cleaner, and drier than those packed.

As would be expected, increased morbidity was suggested by the indices in the following patients: those with extensive neoplasms with local spread as compared with those with early lesions and no spread and those with benign lesions; patients receiving 1500 ml. or more of blood during the operation as compared with those receiving 1000 ml. or less, and patients who had experienced shock during the operation as compared with those who had not. The average time required for the operative procedure was 3.2 hours. The longer the operation, the longer was the postoperative hospitalization (POD), the greater the incidence of complications (CI), and the higher the mortality rate (MR). Since there was no selection of cases related to the ability of the surgeon, the skill and experience of the operator played a minor role, while the body habitus of the patient, the technical problem presented by the lesion, and the operative complications encountered were decisive in determining the length of the operation.

Comment

In considering the results of this study, it is important to remember that the data were obtained by review of case records compiled by more than 50 interns, residents, and staff members. They are therefore subject to inconsistencies and inaccuracies intrinsic in any such accumulation of information based upon many independent observations by multiple examiners. The absence of data concerning the various clinical features being studied indicates either incompleteness of the case records or that the particular examination in question was not done.

The χ^2 and the difference in means methods of analysis have been employed in

testing the statistical significance of the differences observed. None were found to be significant at the 5% level. It is probable that this failure to find statistical significance is related to the paucity of the data rather than the absence of causal relationships.

A model experiment involves observing the results which follow the changing of one variable, all others remaining constant. Controls are necessary to insure that the results observed are related to the variable in question, and not to other unrecognized variables. Clinical investigation does not lend itself to such well-controlled experimentation. There are always multiple uncontrollable known and unkonwn variables contributing to the observed results. Rarely are entirely satisfactory controls possible. In the present study, insofar as possible, separate variables have been independently studied; controls have been used when available in evaluating the results.

The findings suggest that preoperative weight loss, lowered plasma protein levels, and need for preoperative blood transfusion (anemia and/or decreased blood volume) are signs associated with an increased postoperative morbidity and mortality. When the findings in patients with normal plasma proteins and greater than 10 lb. weight loss are examined, there is a clear indication of the marked increased morbidity and mortality associated with diminished blood volume. Certainly a direct measure of blood volume is desirable and provides more precise information. However, when this is not possible, a proper appreciation of the significance of weight loss and hemoglobin levels will indicate those patients with decreased blood volumes. In the patients included in this study, plasma protein (in part), hemoglobin, and blood volume deficits were corrected before operation. We can only speculate regarding the morbidity and mortality which would have been observed if these deficits had not been corrected. Whether or not the morbidity and mortality could have been reduced with a longer period of preoperative preparation, directed primarily to the correction of the nutritional deficit, is also a matter for speculation.

Since the findings indicate no difference with regard to wound complications or general morbidity for the patients with three types of abdominal incisions, the decision as to which is to be used must be made on the basis of body habitus of the patient and the personal preference of the surgeon. However, the evidence is clear that the colostomy should be brought out through a separate wound and sutured to the skin or subcutaneous tissue. Immediate wound and late colostomy complications (stenosis, herniae, chronic infection) and duration of the postoperative stay are thereby reduced. Although more difficult than with midline or paramedian wounds, this can also be accomplished quite satisfactorily with a transverse wound. When complete hemostasis has been obtained and when there has been no contamination of the perineal wound with bowel contents, closure of the wound with posterior drainage shortens the duration of the postoperative stay. However, when these circumstances are not present, closure complicates the postoperative period, reopening of the wound frequently being necessary. Such wounds should be packed and permitted to heal by granulation.

In 1952 we began to use the "two-team" approach for abdominoperineal resection. Since then, with almost no exceptions, the end of the colon has been brought out through a second abdominal wound and sutured primarily. Among 132 consecutive patients operated upon, starting in 1952, there were four deaths, a mortality of 3.0%, compared with a mortality of 9.6% for the preceding five-year period. The morbidity observed in those patients operated upon from 1952 through 1956 is being studied and will be compared with the findings reported herein.

Conclusions and Summary

Preoperative and operative factors have been examined concerning their association to postoperative morbidity in patients who underwent abdominoperineal resection. Mor-

bidity was highest in men (as qualified above), in patients with weight loss, low plasma protein levels, anemia, and extensive lesions, and in older patients. A sutured colostomy brought through a separate wound is attended by fewer wound and colostomy complications than other types of colostomies. Preoperative preparation of the colon, anesthesia, abdominal incisions, position of the patient during the perineal phase of the operation, and duration of the operation were also studied. It is suggested that awareness of the importance of certain preoperative and operative considerations will result in a reduction in the formidable morbidity and mortality which continue to accompany this operation.

Richard Shropshire, M.D., of Washington, D. C., and Bennett A. Joiner, M.D., of San Angelo, Texas, rendered assistance in the collection of the data. Lloyd A. Knowler, Ph.D., Chairman of the Department of Mathematics and Astronomy, State University of Iowa, examined the data for statistical significance.

Department of Surgery, University Hospitals, State University of Iowa.

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Follow-Up on Operation for Urinary Bladder Substitution

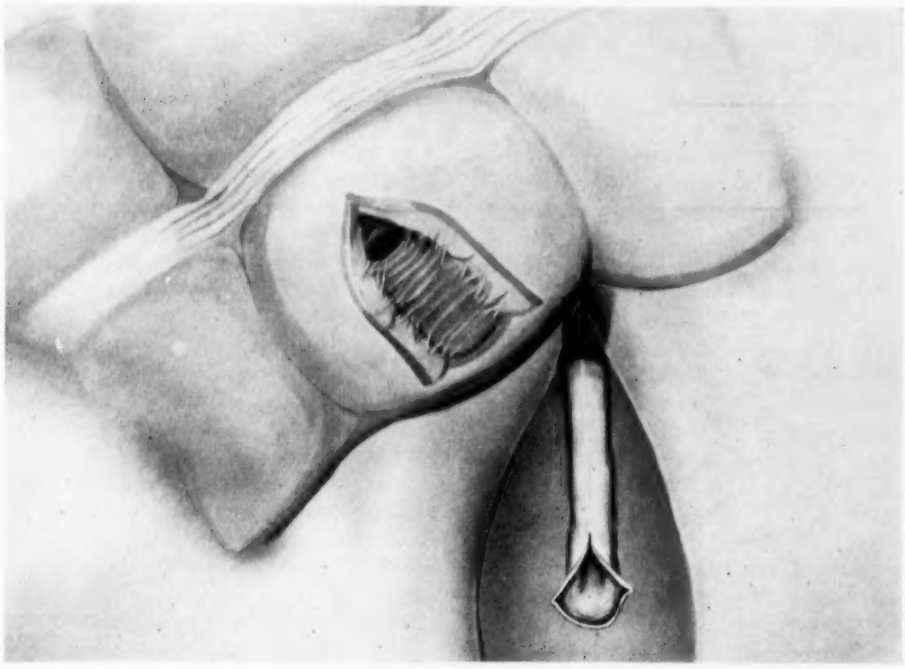
JAMES W. MERRICKS, M.D., and RICHARD K. GILCHRIST, M.D., Chicago

We wish to report on some of the more interesting experiences we have had with the use of the ileocecal-ascending colon type of substitute bladder. The operative technique has been previously described.[1,2] Most of the ureteral implants have been done by a modified Coffey I method. Some anastomoses were made by the combined mucosa-to-mucosa and tunnel technique. We are now spatulating the end of the ureter (Fig. 1). Then the end of the ureter is drawn into the new bladder a short distance by two sutures (Fig. 2). The final position of the ureters in the bladder is shown in an open view of the bladder (Fig. 3). The completed anastomosis (on the right side only) is shown in Figure 4, before the left side has been transplanted and before the bladder has been tacked down over the brim of the pelvis. The ureteral transplantation is done as the last stage in the operation after the pelvic evisceration or cystectomy

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

From the Departments of Urology and Surgery, The Presbyterian-Saint Luke's Hospital, and the University of Illinois College of Medicine (Rush).

Fig. 1.—Spatulated proximal end of right ureter. Trough has been prepared transverse to the long axis of the ileocecal-ascending colon segment.



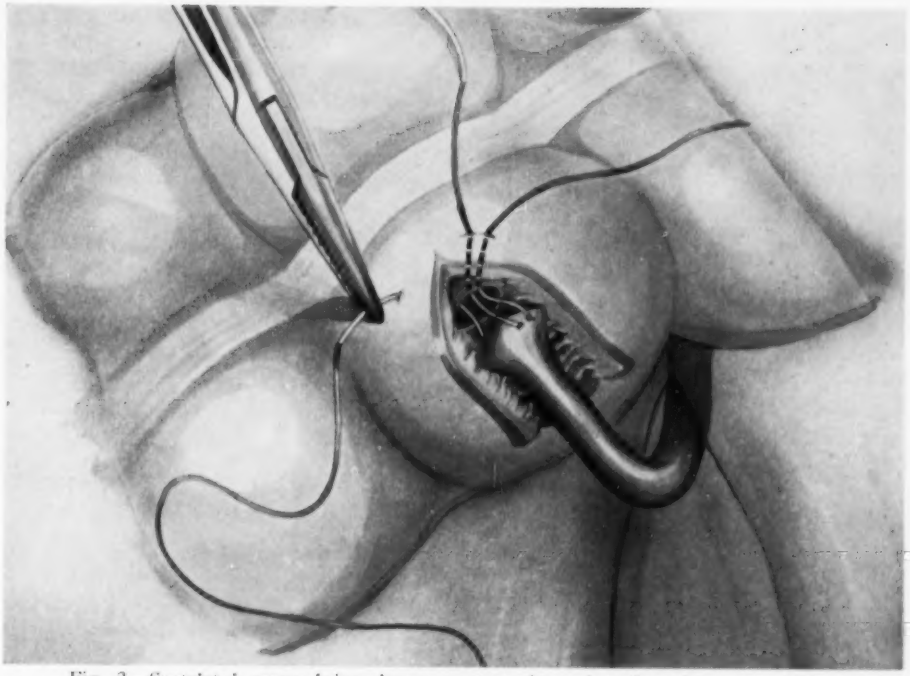
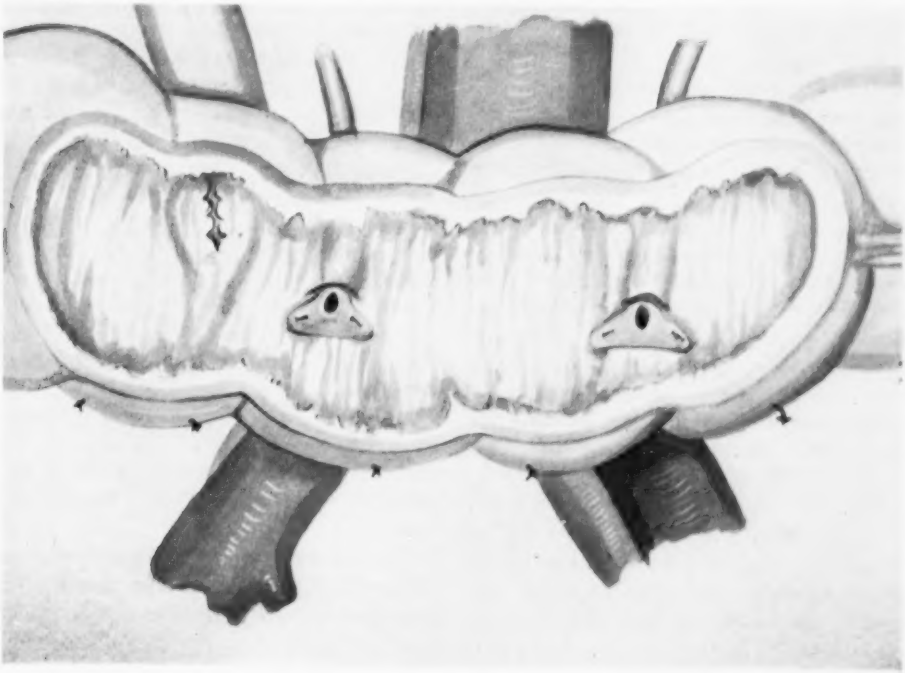


Fig. 2.—Spatulated ureter being drawn up toward opening through mucosa into new bladder. One suture has been placed; second suture, on needle, is being inserted through bowel wall.

Fig. 3.—New bladder in place; anterior wall removed to show, from left to right, ileocecal valve, right ureteral orifice, and left ureteral orifice. Note position of bladder in relation to bifurcation of aorta.



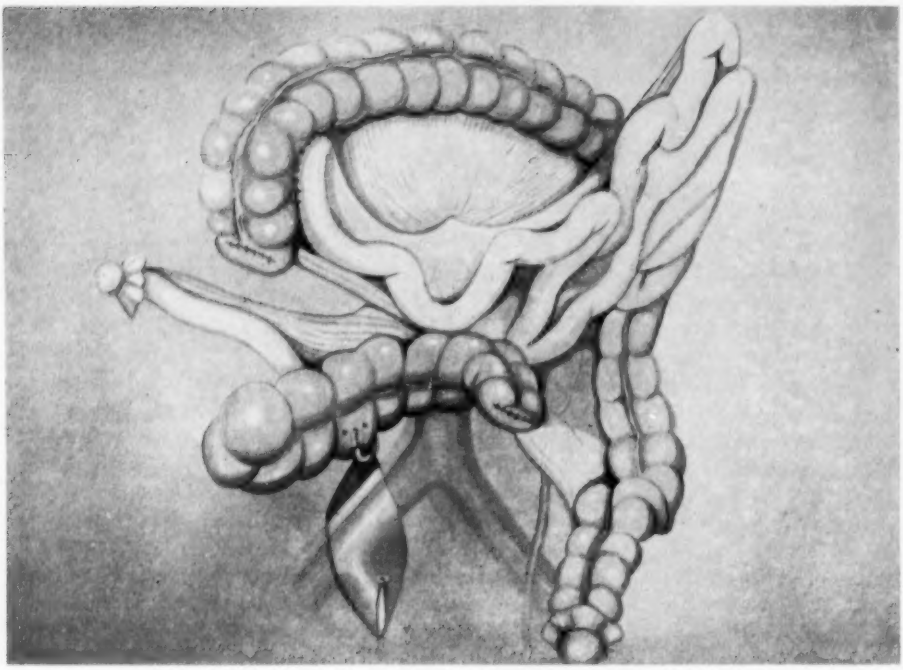


Fig. 4.—Right ureterovesical anastomosis is completed. Ileum-transverse colon anastomosis is completed. Left ureter is to be transplanted next. This patient has a permanent colostomy. End of new bladder to be placed under mesentery of sigmoid colon.

has been done. Absorbable sutures are used throughout.

We have personally operated upon and followed 43 patients. Our most difficult immediate postoperative problem has been obstruction at the site of anastomosis, which occurred in three patients. The ureter was reimplanted in one patient with a single kidney, and in two patients bilateral nephrostomies were done. It is our feeling now that unilateral nephrostomy should suffice, because in both of these the obstruction was apparently due to edema. We still believe that the use of ureteral catheters is unnecessary and may tend to angulate the anastomotic site. We have not seen renal or prerenal anuria.

Other early postoperative complications have been perforation of the bladder wall on the fourth postoperative day. Continuous suction through a soft catheter for nine days allowed the bladder to heal spontaneously. The ileum had to be shortened in one patient a week after operation, as it could not be catheterized. Now we end up with just about 3 or 4 in. of ileum. We do not use a Foley bag postoperatively because not infrequently it is difficult to decompress.

It seems to take about three months for the patient to learn the technique of caring for his new bladder. During this time he irrigates it once a day and fills it to capacity with warm boiled tap water. He gradually learns to live with the new set-up. We have found that a film of several patients in various stages of postoperative recovery, and up to four years after surgery, reassures the patient before the operation and answers most of his questions about personal hygiene. [Film clips from this movie were shown.]

Four patients developed calculi in the bladder from one to three years postoperatively. Nonabsorbable surgical sutures were found

to have worked through from the serosa into the new bladder lumen and acted as centers for calcium deposition. These were easily removed cystoscopically. None required cystostomy.

Late stricture and angulation of one ureteral stoma of a right double ureter was opened by meatotomy and freeing of adhesions by laparotomy almost two years postoperatively. The symptoms had been right pyelonephritis. One other patient with two right ureters had no difficulties.

One patient required a small plastic revision of the ileal stoma two years after operation. This was done under local infiltration anesthesia.

Mucus has tended to diminish with time. We have not been troubled with mucus and have not used irradiation of the bowel preoperatively to reduce mucous secretion. The patients wear either a small pad of cotton under a girdle or a small plastic bottle cap lined with cotton held over the ileal stoma with plastic tape. The catheter, usually an 18 F. double-eye latex type, is carried in a tobacco pouch, small plastic fishhook box, or, in the case of a woman, in a jewelled cigarette box during the winter months or in a light plastic purse in summer. Most patients just moisten the catheter under the tap, drain the bladder, wash off the catheter, and continue on their way, consuming little more time than anyone usually does. This is much simpler than worrying about whether the cement is going to loosen about a bag at an inopportune time. One patient, a banker, is known to have conducted demonstrations of his technique at the slightest provocation. Another is the envy of her friends because of her new capacity at the festive board.

We have used this type of bladder in only one neurogenic bladder patient who was totally uncooperative. Intelligence and cooperation must be evaluated before operation.

Five patients are beginning their fifth year. Four had cancers of the bladder; one, of the cervix. Other survivors are being watched as closely as possible. Blood chemistries are normal in most of the patients. In some, the chlorides may be up one or two points, with normal CO_2. All are urged to return at least once a year for cystoscopic examination, blood chemistries, and excretory urograms. We have not done isotope absorption studies, because they have not, in our opinion, been clinically indicated. Follow-up studies from the cancer salvage standpoint are being done on this group of patients.

Summary

Interesting follow-up facts have been presented in a group of 43 patients with ileocecal-ascending colon type of substitute bladders: Continence without bags has been achieved; these patients lead a normal existence; infection has been no problem; blood chlorides are practically unchanged. These patients do not seem to have more than the normal day-to-day medical problems, unless their tumors overtake them.

104 S. Michigan Ave. (3) (Dr. Merricks)

DISCUSSION

DR. GARFIELD L. SUDER, Cincinnati: I want to congratulate Dr. Gilchrist and Dr. Merricks for the outstanding armamentarium that they have given us, particularly in relation to the continent bladder. All of us who have been faced with diversion of the urinary stream know the grave difficulties that face the patient and the doctor who is responsible for taking care of him.

Numerous techniques have been developed, and are still being developed, because none of these have met all the requirements we would like. Much surgery would be done and much more surgery would be accomplished if we had a safe way of disposing of the urinary tract.

[Slide] As a brief summary, this is a list of some of the different types of diversions that are commonly used at the present time. Of course, we have not mentioned the use of the indwelling Foley catheter.

[Slide] Here is a group of conditions which lend themselves to diversion of the urinary stream. Our experience here has been only with the Bricker type of ileal conduit. I wish to stress, in the use of the so-called ileal bladder, that this is not a bladder by any manner of means. It is only an ileal conduit.

Since some of the problems are similar, we felt we could discuss this paper by presenting some of our problems and a brief résumé of the technique.

[Slide] The ileum is picked up and stained, about 6 in. or so from the ileocecal valve, 6 to 8 in. A small, 6 to 8 in., area of the ileum is isolated between clamps. It has been our experience that, if the segment has been kept to 6 or 8 in. and not more than 9, we do not have any postoperative hyperchloremic acidosis or electrolytic changes. That is the reason for specifying the length of the ileum that is picked up.

It is interesting, I think, that Dr. Gilchrist and Dr. Merricks prefer about the same length of ileum left on the cecum, to use for the antiperistaltic action to preserve the continence of the urine in the cecal bladder.

[Slide] The ileal segment is then separated. The more proximal end is closed. We have had no difficulty with alkali formations in the bladder. The mucosa is closed with an absorbable surgical suture.

We have always felt a little safer if the serosa is reinforced with nonabsorbable surgical sutures, and to date we have not had the occurrence of the sutures migrating into the lumen of the bladder or of calculi forming in these.

Of course, the ileoileostomy is performed superior to the bladders or conduit.

[Slide] This is a view from the rear, looking up from the back, because the anastomosis we are using is done posteriorly, as is done in the cecal bladder.

We have not in this series attempted to make a submucosal tunnel or to obtain a valve-like mechanism at the ureteral-ileal junction. Rather we have hoped to obtain a very patent mucosa-to-mucosa technique.

The more dilated the ureter, of course, the easier this procedure is.

We reinforced our first line. We have tried a mucosa-mucosa, but it has not been too practical. We use a through-and-through suture.

[Slide] This is a follow-up—the final closure of the incision and the ileostomy.

Any of these types of procedures are fraught with numerous problems. I hope we continue to work and obtain a good method of diversion, which will be available to all of us.

Dr. E. Lawrence Keyes, St. Louis: Drs. Merricks and Gilchrist will please excuse me if I say a word on behalf of the St. Louis delegation from a historical point of view. I know Gene Bricker would say this if he were here, namely, that, whereas Dr. Bricker was instrumental in developing the technique, the first ileal bladder was made by Dr. Heinz Haffner, of St. Louis, who is one of our members sitting back there.

I am sure Dr. Haffner would not be the one to say this himself. So, on his behalf, I should like to say that to him is due the credit for the first ileal bladder, as far as I know, and Gene Bricker has said this in print.

Dr. Richard Kennedy Gilchrist, Chicago: I will try to summarize the problems and the points that have to do with continence, the "don'ts" and the complications in this operation.

These are the points to establish continence. First, the bladder must be large enough; if you take a segment of the large bowel with the cecum that is the length of the span of my hand, that bladder will hold 500 to 600 cc. of urine without difficulty. Most patients eventually will go all night without catheterizing themselves. Alcohol does not affect them. Secondly, the continence depends on the fact that the ileocecal valve is competent in at least 50% of the patients. Thirdly, continence depends on the fact, as has been shown by Bolman and Puestow, that fluids will not go in a retrograde manner in the small bowel for more than 5 or 6 in., unless there is real obstruction. Actually, today I think most of the ileal segments from skin to ileocecal valve are not more than 2½ to 3 in. after we are through. Fourth (and I think this quite important) is the fact that we do not excise any skin when we bring the ileal segment through the abdominal wall. It is simply a stab wound. We want a stricture; we do not want a wide opening. We simply pull this piece of ileum out of the abdomen, and just before the patient goes home it is cut off flush with the skin.

As you notice, we hope that by the time the patient is well and continent this stricture is down to where it will take an 18 F. or 20 F. catheter and no more.

Occasionally you will have to do a very slight plastic procedure on the patient. Just nip out a little "V" of skin, so that it is a little larger.

Fifth, it is quite important to place the bladder so that it hangs over the pelvic brim. The ureters are implanted into the superior posterior part of the new bladder, which is rolled upward in order to implant the ureters from behind. The ileum is brought out above and lateral to the ileocecal valve. We pass a catheter through the ileal segment into the bladder before the abdomen is closed. This helps prevent rotation of the ileum and makes certain that a catheter can be passed without difficulty.

The sixth point is training the patient to control his new bladder. He passes a catheter every 3 or 4 hours. If the pouch has not dilated sufficiently to hold 500 or 600 cc. of urine, then warm water is injected after each catheterization to a point of pain, and this is repeated until the proper capacity is obtained.

Now the "don'ts." Don't bring the substitute ileum through the scar. You want the opening to be tight. Don't place the bladder out of the pelvis. If you give the patient radiation, you can expect to have trouble with continence, because the bladder becomes very irritated. You do not do this operation in mentally incompetent or uncooperative patients.

The complication of ascending infection is no problem, except where there has been a recurrent tumor. The same is true of chemical imbalance. Urethral obstruction has not been a problem. One patient lost a kidney because of ureteral obstruction, but she comes back only when she is in trouble. This is about every 18 months. We have spoken of perforation. If there is mucous membrane projecting outside of the skin, it should be excised, as it will secrete mucus and keep the skin moist. These people wear no bag of any sort, simply a piece of gauze and a plastic cover over the opening on the skin.

We no longer use silk. Don't put it in, for it gravitates into the lumen and produces stones in the bladder. One patient, who is just short of five years since his operation, has had a hemorrhagic cystitis, following a very severe upper respiratory infection, which cleared up after treatment.

Mucus in the bladder is no problem. These patients have every bacteria found on the hands, because most of them simply wash the catheter under the faucet. If they get mucus, they take sulfisoxazole (Gantrisin) for a day or two. Every patient is continent, and most of them go all night without catheterizing themselves.

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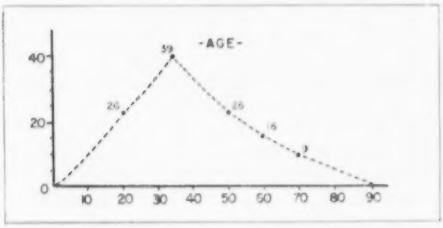
Nonpenetrating Wounds of the Abdomen

RALPH V. BYRNE, M.D., Los Angeles

During the four-year period from 1950 to 1954, 528 patients were admitted to the Los Angeles County General Hospital with a diagnosis of possible abdominal trauma. One hundred fifty-one of these patients had penetrating gunshot or knife wounds of the abdomen, and they were operated upon shortly after admission. Two hundred fifty-one patients were not operated upon and, after clinical observation, x-rays, and laboratory studies, were dismissed, as there was no evidence of intra-abdominal injury. The remaining 126 cases were operated upon for intra-abdominal injury and form the subject of this paper. In nearly half of these patients the injuries were multiple, and the early diagnosis of intra-abdominal injury was very difficult to make. The presence of multiple fractures, head injuries, and lacerated wounds raised the problem of the priority of treatment of the various injuries. Many of these patients were first seen in consultation on the orthopedic and neurosurgical services. In these patients the use of the diagnostic abdominal tap was found to be of great value in making an early diagnosis of intra-abdominal injury.

Age Groups

In certain age groups patients are more prone to become involved in certain types of accidents, and certain types of abdominal injury will be the result. On this basis the cases readily fall into three groups. The largest, or 70% (Figure), were patients between 20 and 60 years of age. The automobile was the commonest cause of the accident; the injuries were multiple in character, and complications were always present. The second largest group were patients between 4 and 20 years. The intra-abdominal injuries were caused by a fall or by a blow or kick to the abdomen. The problem of multiple fractures and their complications was less frequent, and the diagnosis was made by the usual clinical methods. The smallest group were patients between 60 and 80 years of age, most of whom had been struck by an automobile or truck. The injuries were crushing and multiple, and the mortality was the highest; patients in advanced years do not withstand the shock of multiple injuries. In the three groups the youngest patient was 4 and the oldest, 82 years, and there were more male than female patients.



Largest group of patients, between 20 and 70 years of age, were injured in automobile accidents.

Type of Accident

The type of accident in which the patient was involved should suggest certain types of intra-abdominal injuries, and the history is of considerable importance in making a diagnosis. Sixty-six per cent of the patients included in this survey were injured in automobile accidents.

The abdomen may be subjected to three types of violence in automobile accidents: crushing, direct, and indirect. The steering

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

From the Surgical Services of the University of California School of Medicine at Los Angeles and the Los Angeles County General Hospital.

wheel is the commonest instrument in producing crushing injuries of the abdomen and always involves the driver. Direct blows to the abdomen come from the dashboard or back of the front seat, and the passenger is usually the recipient. The driver and passengers are subject to indirect violences to the abdomen in accidents in which the automobile overturns, and although they may walk away from the accident, they should be hospitalized for observation for possible intra-abdominal hemorrhage from a ruptured spleen.

In 32 cases the injuries were sustained by a direct kick or blow to the abdomen or by indirect trauma in a fall. In these patients the injury was usually a single injury, abdominal in character, without the presence of fractures or other complications. In 14 patients a history was not obtainable before surgery because of alcoholism, coma, language difficulty, or concussion. In the presence of alcoholism, a diagnosis of perforated ulcer has been made occasionally, and at surgery a traumatic abdomen was present.

A very small group of patients were struck by automobiles. Their injuries were multiple, severe, and crushing, and the mortality was high. This type of accident is not uncommon, but many of the patients succumb to their injuries before surgery is instituted.

The number of patients involved in different types of accidents is given in the following tabulation:

Automobile	68
Pedestrian	12
Blow	26
Fall	12
No history	14

Clinical States

The three clinical states which accompany multiple injuries and mask the local findings of intra-abdominal injury are shock, hemorrhage, and concussion, and one or more of these conditions may complicate the injuries. Multiple fractures, lacerated wounds, contusion, and hemorrhage may be present. These injuries and their complications present a problem in the priority of treatment and focus the attention of the clinician away from possible intra-abdominal injuries. The use of the diagnosic abdominal tap will aid in making an early diagnosis. Shock should respond rapidly to adequate treatment, and if this does not occur or if the patient's condition becomes worse, intra-abdominal hemorrhage should be suspected and a tap made. The amount of blood loss from external wounds can usually be estimated, and if adequate replacement does not bring the desired results, intra-abdominal hemorrhage should be suspected. Sudden collapse following an apparently trivial accident, or one in which there is no evidence of external violence, should suggest intra-abdominal hemorrhage from a ruptured spleen. Retroperitoneal hemorrhage from fractures of the pelvis or vertebrae or injury to one or more kidneys will produce the clinical picture of hemorrhage and may simulate intra-abdominal injury. The diagnosis of intra-abdominal injury in the presence of head injuries and concussion is most difficult, and the use of the abdominal tap has been most useful in these cases.

In 74% of the patients operated upon for intra-abdominal injury, one or more of these clinical states were present in varying degrees, and peritoneal aspiration was used to make an early diagnosis. In the 82 cases in which the tap was used, a positive tap was obtained in 78, and the accuracy of the procedure confirmed at surgery. In four cases the taps were negative, and subsequent surgery showed intra-abdominal injury. Delayed hemorrhage from a ruptured spleen or liver may occur after the diagnostic tap has been made, and, with increasing experience, a repeat tap is now made 24 hours later in any patient with suspected intra-abdominal injury who is not progressing satisfactorily. In 26% of the patients operated upon for abdominal injuries, multiple injuries were not a problem; shock, if present, was brief; the presence of hemorrhage was manifested by the usual local signs; the symptoms pointed to the abdomen

as the source of injury, and the diagnostic tap was not used.

The following tabulation shows that, while localized abdominal findings were present in one-third of the patients operated upon, in two-thirds they were masked by complications:

Pain and tenderness	46
Shock	39
Hemorrhage	15
Concussion	20
Alcoholism	3
Coma	3

The optimum condition for an accurate diagnosis with the abdominal tap is intra-abdominal hemorrhage from trauma to the liver or spleen. The second commonest condition for diagnosis is in retroperintoneal hemorrhage from a ruptured kidney or fractured pelvis, in which case the diagnostic tap is negative for blood or fluid, and there is no intra abdominal hemorrhage or injury in the gastrointestinal tract. In the presence of a perforation of the gastrointestinal tract, the spill is usually general, and the tap is accurate; however, if the spill is minimal or walled off, or retroperitoneal, as in the case of the duodenum, laparotomy must be used. In the 82 patients on whom the diagnostic tap was used, blood, bile, air, fecal matter, pancreatic juice, small bowel contents, and stomach contents were recovered. The early pitfalls in the use of this procedure were found to be the following: Using a one- or two-quadrant tap in place of the usual four-quadrant tap; failure to repeat the procedure in patients whose general condition became worse in the presence of adequate treatment, and failure to follow properly the usual laboratory procedure and to use the diagnostic tap as a short cut to diagnose. The greatest value to the patients from this procedure is much earlier abdominal surgery, where previously a watchful-waiting attitude had been followed.

Regional Fractures

It has been found to increase the efficiency of the emergency treatment of severely injured patients to associate fractures in certain regions of the body with certain possible intra-abdominal injuries, as with certain complications that may delay the diagnosis of intra-abdominal injury, rather than to be concerned with the specific bones involved. In 19 patients the fractures were limited to the chest and lower ribs, and intra-abdominal hemorrhage from the spleen and liver was present in all. Pulmonary injury with breathing and circulatory difficulty becomes a pressing problem in these injuries. Multiple fractures of one or more extremities were present in 17 patients; abdominal injuries were present, and surgery was necessary. Fractures of the extremities are good evidence of the severity of the accident in which the injuries were received. If intra-abdominal injury is present, it follows indirect violence, and the spleen is the organ most likely to be injured. Fracture of the pelvis in 15 patients was associated with intraperitoneal rupture of the bladder in two cases and in all patients produced lower abdominal symptoms and varying degrees of retroperitoneal hemorrhage. Skull fractures in 10 patients produced concussion which masked all signs of intra-abdominal injury. Although it is not always the domain of the general surgeon to treat these fractures, their presence in certain regions of the body should increase his index of suspicion of certain possible injuries to the abdominal organs.

Pathology

The spleen and the liver were the two most vulnerable organs from the standpoint of frequency. The intra-abdominal hemorrhage may be immediate or delayed, subject to the presence of shock, with a fall in blood pressure, or certain local conditions, such as the type of tear and the portion of the organs damaged.[1] The violence may be direct and frequently associated with rib fracture or may be indirect without external evidence of injury. Injury to the gastrointestinal tract with tear or perforation and peritonitis comprised the second largest

group of injuries. Fixation of the intestinal tract by ligament and mesenteries and the presence of the long spine place the commonest point of injury to the small intestine in the proximal jejunum and distal ileum. Direct violence, such as a blow or kick to the abdomen, will produce a tear in any viscus directly beneath or adjacent to the injury, and the cecum, sigmoid, gallbladder, and pancreas have been traumatized. The most commonly overlooked injury is in the second and the third portion of the duodenum because of its retroperintoneal position. The stomach is seldom damaged, and only after a crushing type of injury, because of the protection from the lower rib cage. The gallbladder was injured in three patients, the urinary bladder, in two, and the diaphragm ruptured in two. In only 10 patients were one or more organs ruptured or torn, in marked distinction to the multiple organ damage sustained in gunshot or stab wounds of the abdomen. The mortality in this series of cases was 10%. Three patients died on the operating table, and seven postoperatively of lower nephrosis.

Summary and Conclusions

The following pattern is suggested to increase the efficiency in the treatment of nonpenetrating injuries of the abdomen.

1. An accurate history of the type of accident should be obtained to determine whether the violence to the abdomen is crushing, direct, or indirect.

2. In the presence of multiple fractures, the region of the body involved should suggest the possibility of injury to certain organs in the abdomen.

3. In the presence of shock, hemorrhage, or concussion, the diagnostic abdominal tap should be used to make an early diagnosis, rather than following the procedure of watchful waiting.

4. Delayed hemorrhage in the abdomen from rupture of the spleen or liver makes it necessary to repeat the tap in certain cases.

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DISCUSSION

DR. WAYNE CHRISPIAN BARTLETT, Wichita, Kan.: The point that Dr. Byrne made with reference to the retroperitoneal portion of the duodenum is especially important, and I believe Dr. Ed Miller, of Chicago, at this meeting some time back emphasized that point.

A tap at this point will not demonstrate any positive findings, but the x-ray findings are rather significant, though they may not show up for several hours.

The peculiar bubbly appearance of the retroperitoneal tissues, which appears like emphysema, becomes distinct and particularly so down the right psoas muscle and the kidney on the right side.

If that condition is present, then certainly a person should operate upon a patient. It may go for several hours, though, without very clear manifestations, and those patients are frequently in rather serious trouble by the time the diagnosis is made.

There are two or three other things that I think should be remembered. We have seen recently a case of rupture of the stomach without penetrating wounds, in which there were no findings other than ileus by x-ray. That particular patient had multiple fractures and a smaller mental bursal-space gastric perforation. The patient was admitted on the orthopedic service, and the condition was not detected for several days.

There are other things that may come up. We have seen an instance of a penetration of the liver through the diaphragm, in which there would have been no abdominal findings. One other case I would like to mention briefly is that of a patient in whom there would have been findings had a tap been done in this way. A seat buckle in a car seriously damaged the liver, producing a deep laceration in the median portion of the right lobe near its junction with the left lobe.

DR. GROSVENOR T. ROOT, Oakland, Calif.: Dr. B. H. Christensen and I have recently reviewed the records of 1988 patients who were seen in the Emergency Department of Highland-Alameda County Hospital as a result of automobile accidents in 1955. We were amazed to find that, out of this series, only 44 patients had even the slightest abdominal symptoms. Thus, abdominal injuries rarely occur in victims of automobile accidents. However, when they do occur, they are extremely important, as evidenced by the fact that, of the 45 deaths in the series, 20 persons, or 44%, had abdominal injuries, alone or associated with injury to other systems. When projected nationwide, of the 38,000 deaths which occurred in 1955 from traffic accidents, one would find that several thousands were due to abdominal injuries. One sees the added importance of the diagnostic ab-

dominal tap if it may encourage us to employ earlier abdominal exploration in some of the more complicated cases.

I have had no personal experience in employing the diagnostic abdominal tap; however, one of my surgical colleagues in Oakland, Dr. George Lee, did become very interested in this subject during his residency at Highland-Alameda County Hospital. He used the four-quadrant abdominal tap as a diagnostic procedure in 50 patients with acute abdominal findings. He found it to be of particular benefit in the very young and the very old patient as well as in the patient with multiple injuries, as emphasized by Dr. Byrne. However, at Highland-Alameda County Hospital we have not been employing the abdominal tap as a routine diagnostic procedure in acute abdominal emergencies but have used it only on occasions, particularly in patients who have multiple injuries with questionable abdominal injuries, as emphasized by Dr. Byrne.

Dr. Cyril Joseph Costello, St. Louis: I wish to compliment Dr. Byrne for what I consider a very timely presentation. He has encouraged me to say a word about our experiences with blunt abdominal trauma at St. Louis City Hospital and to admit that we have been unduly horrified to find that our pediatricians seem to have no compunction about perforating the abdominal wall with a needle.

About 10 years ago I reviewed the cases of blunt abdominal trauma with intra-abdominal hemorrhage and discovered that the rate of preoperative diagnosis was surprisingly good. At the same time there were a number of cases in which it was evident that the diagnosis was missed or delayed until final operation or autopsy. These could possibly have been discovered by abdominal tap.

Most of those patients were ones who had sustained serious concomitant injuries, particularly head injuries, and they could not cooperate in presenting the symptom of pain or in localization of tenderness.

I agree completely that there are some instances in which the diagnosis cannot otherwise be made early except by tap, and I wish to suggest that Dr. Byrne's experience be emphasized by all of us on the smaller traumatic services of private hospitals and that we actively encourage the use of this diagnostic procedure increasingly.

Dr. William Henry Requarth, Decatur, Ill.: I should like to make three points. First, I agree with Dr. Byrne that the diagnostic abdominal tap is of value. It must be used with other methods of diagnosis, but in some cases it is the only indication that actual abdominal injury exists, particularly when there are other associated skeletal injuries. Secondly, I would like to emphasize that the flat plate of the abdomen is a very useful tool. [Let me have the first slide please.]

[Slide] Here is a child that was in an automobile accident, was admitted in shock, and you can see the marked gastrectasis which is frequently present. This child had a ruptured spleen. Diagnostic tap here was positive.

[Slide] And here again is a patient with a marked dilatation of the stomach, and diagnostic tap was positive. This child had a ruptured liver.

[Slide] This particular patient had very severe trauma, but the stomach was ruptured, and there is no dilatation of the stomach here. However, he did have intraperitoneal air.

[Slide] This shows the displacement of the hepatic flexure of the colon we often see in retroperitoneal hematomas after rupture of the spleen.

[Slide] And here again is the displacement demonstrated by the barium enema rather than a gas pattern.

[Slide] This is a case in which the x-ray was not specific, but here again a diagnostic tap was positive.

The third point I would like to make is the importance of examining the base of the mesocolon in all patients that are explored for nonpenetrating wounds because of the possibility of finding a rupture of the retroperitoneal part of the duodenum. This should be done, even though other lesions, such as rupture of the spleen, are found in the abdomen.

Dr. Jacob K. Berman, Indianapolis: I should like to suggest just one additional diagnostic aid in determining which of these patients with nonpenetrating abdominal injuries should be explored.

Dr. Vernon Lee and I began these studies 10 years ago and published them in the *Journal of the Indiana State Medical Association*. Recently Drs. Habegger, Fields, Kilmer, and I have reviewed our entire series of abdominal injuries.

There were 338 consecutive cases which came to surgery. They were categorized into nonpenetrating and penetrating wounds of the liver, the spleen, the intestine, the kidney, the retroperitoneal area, and other organs. Our findings, very briefly, were as follows.

A patient with a nonpenetrating abdominal injury, or one who has been injured and the extent of his injuries is not known, should have an immediate blood count. If his white corpuscles number more than 15,000, the patient probably has a lacerated liver or spleen. In more than 95% of these cases this was verified at operation. This is not true when the injuries are due to stab wounds or gunshot wounds.

The leukocytosis is apparently not dependent upon the amount of blood in the peritoneal

cavity, as judged by hemoglobin determinations and by the amount of blood loss as estimated by the surgeon. Moreover, in 81 cases of ruptured ectopic pregnancy the leukocyte count did not approach these levels, even though the surgeon described the amount of blood in the peritoneal cavity as large or massive.

We do not know the causes for the increase in leukocytes. Presently we are having routine blood cultures done on these patients, because we believe that perhaps—and this is only a conjecture—the disruption of large numbers of reticuloendothelial cells in the liver and spleen may provide an antigen which stimulates the prompt leukocytic response. It is probably not due to alterations in blood volume, because, if anything, the number of leukocytes should decrease, owing to hemodilution following blood loss.

Therefore, in any nonpenetrating wound, an immediate blood count should be done and repeated in 30 minutes. If the leukocytosis exceeds 15,000, one can bet 95 times out of 100 that the patient has a lacerated liver or spleen or both, provided, of course, that clinical symptoms and signs are corroborative.

DR. EDWIN M. MILLER, Chicago: There is just one question I would ask Dr. Byrne that has to do with the reliability, or rather the dependability, of the abdominal tap as far as furnishing an indication for surgical interference. It is easy to understand, of course, how a positive tap, with the demonstration of blood, intestinal content, or free air in the abdominal cavity, can be very useful to the surgeon; yet, it is also easy to understand how a negative tap may be quite misleading and might deter the surgeon from operating when the bleeding or perforation of the bowel is extraperitoneal, i. e., in the retroperitoneal portion of the duodenum.

DR. RUDOLF JUUL NOER, Louisville: A word should be said, I believe, about the importance of not delaying too long for diagnostic procedures, when there is real suspicion that intra-abdominal injury has been sustained.

Sometime ago, I think it was before the war, it was my privilege to hear Dr. Willis Gatch talk about the deceptiveness of the physical findings in children. I believe he made the statement, if I remember correctly, that he had seen two or three children in rather close succession, across whose abdomens a wheel had passed, who showed remarkably little on physical finding but who later showed evidence of serious intra-abdominal injury.

I am sure that this is true not only of children but of adults, and I think that, even though the physical findings are minimal, if there be evidence that the trauma has been severe, the patients should be explored.

A word too about the abdominal tap. I believe it should be used only by persons who are willing to say, if it is negative, that it means nothing. If it is positive, it is very helpful, but I think a negative abdominal tap should be ignored in the study of the patient.

DR. RALPH V. BYRNE, Los Angeles: In answer to Dr. Miller's question, in an article which was recently published in *Surgery, Gynecology, and Obstetrics*, we presented a series of 100 consecutive cases in which this method of diagnosis was used with an accuracy of 83%. Our experience has been that a considerable amount of the accuracy depends on the man who uses the tap; we have found that a resident will frequently get a positive tap, whereas an intern who is not interested in the diagnostic abdominal tap and who may fail to make a four-quadrant tap may miss the diagnosis.

Our experience leads us to believe that this tap should be used only in those patients in whom there are multiple injuries and complications, and obviously the treatment of these complications will sometimes mask the loss of blood.

A fairly normal blood pressure will be sustained, and the point is that, even though laparotomy may be delayed for four to six hours, an early diagnosis of intra-abdominal injury is the most important fact.

REFERENCE

1. Byrne, R. V.: Splenectomy for Traumatic Rupture with Intra-Abdominal Hemorrhage: Report of One Hundred and One Cases, Arch. Surg. 61:273-284, 1950.

The Influence of the Burn State on the Turnover of Serum Proteins in Human Subjects

TRUMAN G. BLOCKER Jr., M.D.; WILLIAM C. LEVIN, M.D.; JOHN E. PERRY, B.S.; STEPHEN R. LEWIS, M.D., and VIRGINIA BLOCKER, M.D., Galveston, Texas

Despite the large amount of data accumulated by balance studies and by similar methods of studying the pattern of response to burns and other trauma, the basic physicochemical disturbances involved require considerable clarification, particularly the relationship of the catabolic and anabolic processes of protein metabolism. In 1952 Pollack and Halpern, in the manual on "Therapeutic Nutrition" [17] sponsored by the National Research Council, set forth arguments against the theory of blockage of protein synthesis during the so-called "catabolic phase" following injury and infection, but stressed the fact that "the critical experiment designed to show whether or not any anabolism occurs" during the period "remains to be reported," adding that "the administration of an isotopically labeled amino acid during this phase and its subsequent incorporation into body proteins would prove that anabolism was taking place." Since that time the "critical experiment" has been performed many times, and it is hoped that techniques may be worked out eventually in which protein anabolism and catabolism may be measured as separate phenomena.

With the use of L-methionine labeled with S^{35} we have been interested in studying for the past several years the protein disequilibrium which occurs after mild and severe burns and have found this compound a satisfactory research tool for investigative purposes. Previous reports [4,11,13] have dealt with evidence to confirm the normal state of protein metabolic equilibrium, as described first by Schoenheimer and Whipple,[26] the finding of increased rates of catabolism in severe burn patients in whom equilibrium is not established until late in convalescence, and the indication that anabolic processes may also occur at accelerated rates during the period of "negative nitrogen balance." It has also been demonstrated by an in vitro experiment [12] that, since adsorption of S^{35}-labeled L-methionine by the serum proteins does not occur to any significant degree, uptake in all probability represents true biosynthetic incorporation.

The present study is a comparison of serum protein turnover data in four groups of patients following intravenous administration of labeled L-methionine: normal hospitalized controls; nutritionally depleted subjects; mild burns, and severe burns.

Method

Following intravenous administration of approximately 100μc of S^{35}-labeled L-methionine, blood samples were drawn hourly for 8 hours, then at daily to biweekly intervals for 21 to 36 days. Twenty-four-hour urine specimens were collected for four days after injecting the tracer.

Duplicate samples of 0.2 ml. of serum and 1.0 ml. of urine were prepared in weighed cupped metal planchets and dried in an oven at 40 C for 24 hours. The protein-free fraction of the serum was separated by precipitating duplicate samples of 0.2 ml. of serum with 95% ethyl alcohol and extracted with chloroform and water. The water layer, containing the protein-free fraction of the serum, was drawn off, placed in planchets, and dried. The serum and urine samples were reweighed after drying. The weights of the samples were used in calculating self-absorption correc-

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Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

From the Departments of Surgery (Plastic and Maxillofacial) and Internal Medicine, The University of Texas Medical Branch.

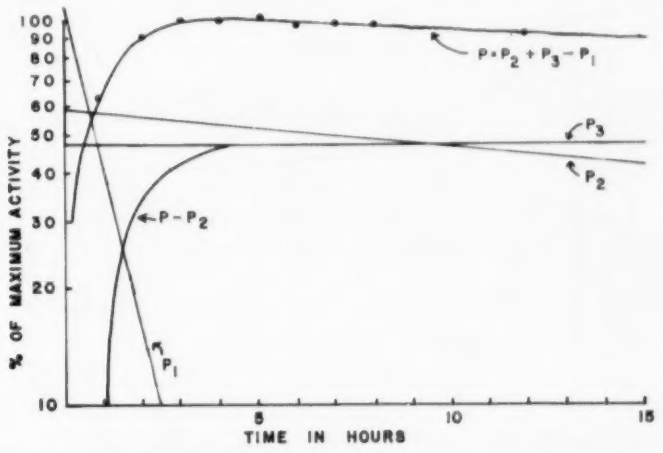

FIGURE 1. A GRAPHIC REPRESENTATION OF THE BIOLOGICAL INCORPORATION OF SULFUR-35 LABELED L-METHIONINE INTO SERUM PROTEINS.

tions. Standards were prepared by dilution of the same solution which had been administered intravenously.

Owing to the difficulty in measuring the soft beta particle (0.17 mev) of S^{35}, the samples were counted in a windowless gas flow detector of the preflush type.

Calculation

The activity of the serum protein was obtained by subtracting the count of the protein-free fraction from that of the serum and plotted against time. The highest count was designated as the peak activity and was given the value of 100%. The remaining samples were expressed as the per cent of the peak activity and were graphed on semilogarithmic paper.

The plasma volume was estimated by using body surface, body weight, or the Evans blue dye technique. The amount of labeled methionine incorporated into the serum proteins at the peak was expressed as the per cent of the injected dose in the circulating intravascular serum. Urine excretion was expressed as the per cent of the injected dose in each 24-hour urine sample.

The curve obtained for serum protein activity plotted against time—P—was found to be composed of two parts with three components, P_1, P_2, and P_3. P_1 represents the incorporation of the labeled amino acid into the serum proteins (Fig. 1). P_2 and P_3 represent, respectively, disappearance of the compound from the intravascular to the extravascular compartment (Fig. 2) and the catabolic phase of the die-away curve. These components were determined mathematically by extrapolation and subtraction, after which the half-times $T\frac{1}{2}$ (or T_1, T_2 and T_3), and zero axis intercepts were calculated for each.

The component P_3 (Fig. 2) was obtained by drawing a straight line through the points at the far side of the die-away curve and extrapolating back to the zero axis. By subtracting the ordinates of P_3 from the corresponding ordinates of the original curve, P, points are obtained through which the straight line representing P_2 is drawn. In order to obtain the remaining component, P_1 (Fig. 1), the uptake curve was used, and the lines representing P_2 and P_3 are drawn on this graph. By subtracting P_2 from the uptake curve and by subtracting these points from P_3, points were obtained through which the straight line representing P_1 could be drawn.

The relationship which exists between the activity in the plasma protein and time can be expressed by the equation $P=P_2+P_3$

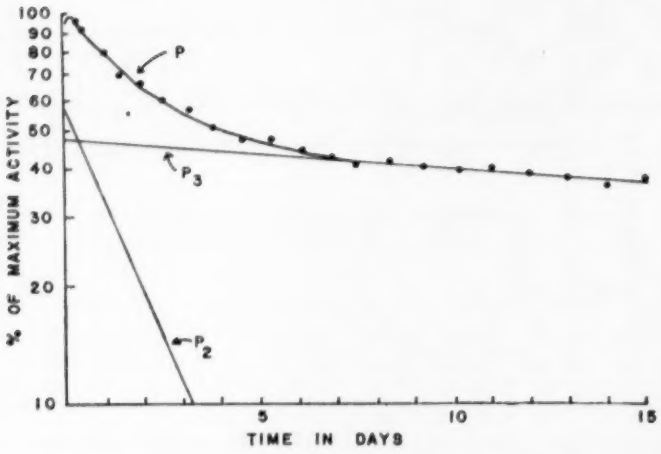

FIGURE 2. A GRAPHIC REPRESENTATION OF THE DISAPPEARANCE OF BIOSYNTHETICALLY LABELED SERUM PROTEINS FROM THE INTRAVASCULAR COMPARTMENT.

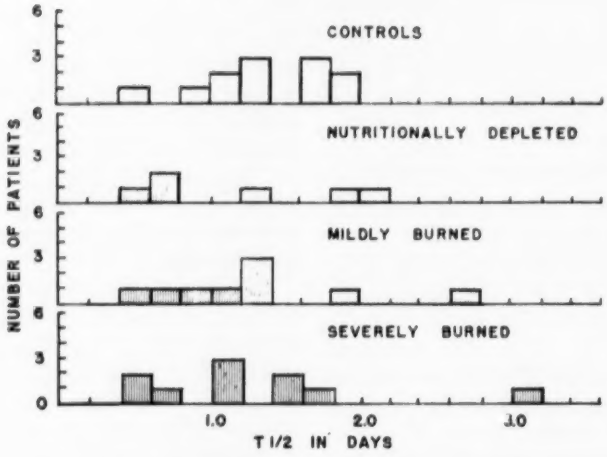

FIGURE 3. A COMPARISON OF HALF-TIMES OF THE SECOND COMPONENT (TRANSFER PHASE) IN PATIENTS STUDIED.

$-P_1$. Since P_1, P_2, and P_3 are straight lines when drawn on semilogarithmic graph paper, they can be expressed as follows:

$P_1 = a_1 e^{-k_1 t}$

$P_2 = a_2 e^{-k_2 t}$

$P_3 = a_3 e^{-k_3 t}$

where

a_1, a_2, and a_3 are the intercepts of the components P_1, P_2, and P_3 on the zero axis, and $-k_1$, $-k_2$, and $-k_3$ are the slopes of these components. Using these substitutions, the equation can also be written

$P = a_2 e^{-k_2 t} + a_3 e^{-k_3 t} - a_1 e^{-k_1 t}$*

data is being prepared for early publication.

Results

The half-time, T_2, of the second component, which represents the initial trans-

* More complete mathematical analysis of these

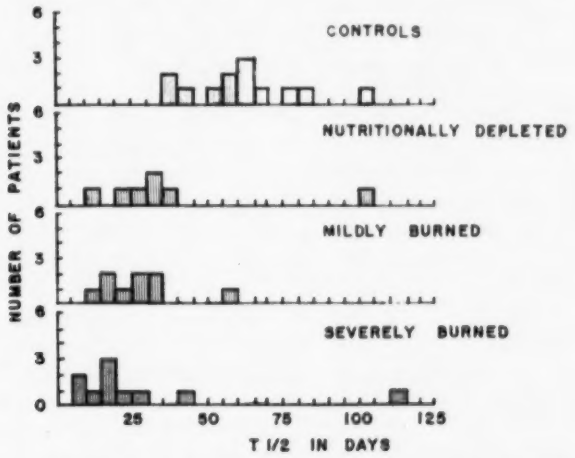

FIGURE 4. A COMPARISON OF T I/2 OF THE THIRD COMPONENT (APPARENT CATABOLIC PHASE) IN PATIENTS STUDIED.

fer phase, was obtained in 12 control, 6 nutritionally depleted, 9 mildly burned, and 10 severely burned patients, as shown in Figure 3. From these results it can be seen that there is no correlation among the various groups and that there is no significant difference between the control and the burned group in the initial disappearance of the newly synthesized protein from the intravascular compartment. Hubay and associates[9] made a similar observation using I^{131}-tagged albumin in normal and hypoproteinemic persons.

The half-time, T_3, of the third component, which represents the catabolic phase of the die-away curve in 13 control, 7 nutritionally depleted, 9 mildly burned, and 10 severely burned patients, is depicted in Figure 4. Here T_3 in the control group varied from 37.6 to 104 days. T^3 in the group of

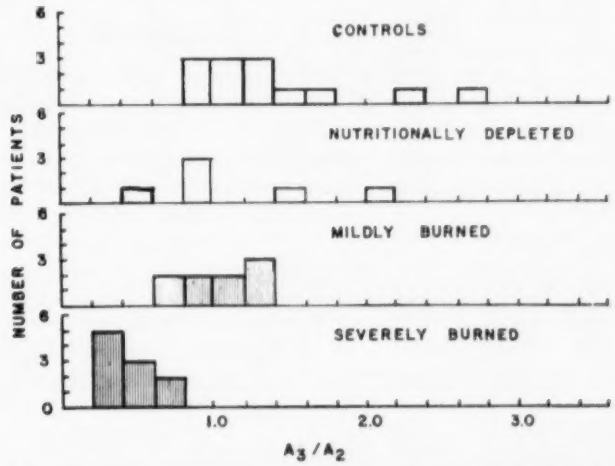

FIGURE 5. A COMPARISON OF THE RATIO OF THE INTRAVASCULAR (A_3) TO THE EXTRAVASCULAR (A_2) PROTEIN POOLS IN PATIENTS STUDIED.

TABLE 1.—*Per Cent of Administered Dose of S^{35} Labelled L-Methionine Incorporated into the Intravascular Serum Proteins at the Peak*

Control Patients		Nutritionally Depleted Patients		Mildly Burned Patients		Severely Burned Patients	
Patient, No.	Per Cent of Dose	Patient, No.	Per Cent of Dose	Patient, No.	Per Cent of Dose	Patient, No.	Per Cent of Dose
35	11.7	42	15.0	55	12.4	29	48.5
44	11.1	53	14.6	56	15.1	39	28.0
49	12.7	54	23.5	59	24.6	40	29.2
50	17.3	57	14.3	62	13.3	47	20.6
51	13.4	64	20.9	63	18.0	60	19.8
52	16.5	69	11.3			65	24.9
58	13.7					67	13.0
						68	11.3

nutritionally depleted patients, except for one, ranged from 11.9 to 36 days. One psychotic patient, who presented an unusually advanced case of starvation, had a T_3 of 101 days.

Eight mildly burned patients had a T_3 from 12 to 32.6 days; one had a T_3 of 55.8 days. Eight of the severely burned group demonstrated a catabolic half-time varying from 6.4 to 28.3 days; one had a T_3 of 43.2 days. Another severely burned patient, however, who received intensive steroid therapy during the postburn period, had a T_3 of 110 days.

The ratio of the zero axis intercepts of the third and second components, a_3/a_2, represents the relation of the intravascular and extravascular protein pools to each other.[25] From Figure 5 it can be seen that a significant difference exists between the controls and the severely burned patients. The ratio, a_3/a_2, for the controls varied from 0.80 to 2.7, while in the severe burns it varied from 0.24 to 0.74. These results indicate that in severely burned patients there exists a relatively larger extravascular protein pool than in the hospitalized control group.

The per cent of the administered dose of labeled methionine incorporated into the serum proteins at the peak is tabulated in Table 1 for each group of patients. It can be seen that the amount of the tracer taken up by the serum proteins in the nutritionally depleted, mildly burned, and severely burned groups is either within the range of the control group or greater than normal. In no instance was the uptake lower than in the control group.

The urinary excretion of S^{35}, expressed as the per cent of the administered dose of labeled L-methionine in the first 24-hour specimen, is shown in Table 2. The urinary excretion of the label by the nutritionally depleted, mildly burned, and severely burned groups either was in the control range or was greater than normal.

Comment

When a labeled amino acid is administered intravenously, its concentration in the blood falls at a rapid rate. After a short delay, the label begins to appear in the plasma proteins.[16,21,26] The activity of the plasma proteins rises rapidly to reach a peak

TABLE 2.—*Per Cent of Administered Dose of S^{35} Labelled L-Methionine Excreted in the Urine During the First Day After Administration*

Control Patients		Nutritionally Depleted Patients		Mildly Burned Patients		Severely Burned Patients	
Patient, No.	Per Cent of Dose	Patient, No.	Per Cent of Dose	Patient, No.	Per Cent of Dose	Patient, No.	Per Cent of Dose
35	12.2	42	9.9	55	8.0	39	31.9
44	4.2	53	12.6	62	27.6	47	8.2
49	7.9	54	11.0	63	28.8	60	38.6
50	9.8	57	7.2			67	16.1
51	6.4	69	4.0				
52	16.9						
58	7.6						

between two and one-half and eight hours, and once the peak is reached it falls to reach a semiequilibrium between four and eight days. After this time the activity falls at a much slower rate until eventually the specific activity of the plasma protein is the same as all other organ proteins.[1,3]

During the period of rise in activity of the plasma proteins the labeled amino acid is also being used for protein synthesis by all other organs of the body.[26]

The die-away curve, when plotted on logarithmic scale, can be separated into two phases. The first phase, which occurs between the peak and eight days, when it reaches an equilibrium, represents the passage of radioactive protein from the intravascular compartment to the extravascular compartment.[7,8] The second, or slower, phase represents the utilization of plasma protein by body processes to form tissue proteins and the reutilization of tissue protein metabolites to form additional plasma protein.[1,14,16] Because of the reutilization phenomenon, this second phase does not represent catabolism alone but also a hypothetical anabolic curve (T_4) which cannot be measured by present methods. Since the labeled metabolites of tissue protein are diluted in a large pool of nonlabeled plasma protein precursors, the radioactivity reincorporated into the plasma proteins is not as large as might be supposed. Yet, reutilization of these metabolites does result in a longer apparent turnover time than would be observed otherwise.

If previously labeled plasma protein were injected intravenously, the same type of die-away curve would be noted.[1,24] In this case the labeled metabolites available for resynthesis of plasma proteins are derived only from the radioactive plasma proteins and not from tissue proteins. This results in a much smaller amount of labeled plasma protein precursors available for reutilization, and the reutilization phenomenon in this case is relatively insignificant.

In a state of metabolic equilibrium, where the plasma protein pool and the ratio of the extravascular and intravascular pools remain constant, the amount of protein catabolized in a given time is the same as the amount of newly synthesized protein formed to take its place, and the $T\frac{1}{2}$ of a given quantity is a good index of protein turnover. In the various types of metabolic imbalance there are many factors which may affect protein turnover, e. g., stress, malnutrition, increased renal and extrarenal losses, hormonal influences, and diet.[2,5,6,10,18,20,22,23] Very little is known with regard to protein synthesis per se following injury, although Madden's work [15] with experimental abscesses in dogs must be cited.

The turnover rate of plasma proteins in our series cannot be measured because of lack of exact data with regard to the size of the plasma protein pool [18,21]; with the indirect evidence at hand, however, we can attach some significance to the half-time values for the catabolic curve. Our results indicate that in burned patients the size of the extravascular pool is relatively larger than that of the intravascular pool. Since these cases show blood volume and total serum protein concentration values within normal limits, it can be assumed that the size of the total protein pool is probably also normal, or only slightly less than normal, and also that the differences noted between half-times of normal and abnormal patients in our series and the differences between the percentage of the injected dose of label taken up at the peak are valid. In spite of the reutilization phenomenon, therefore, the apparent turnover of plasma proteins in the burned patient is more rapid than normal, and anabolism occurs at either normal or accelerated rates, depending upon individual clinical variations.[4,11,13]

Our values on urinary excretion, though reported on only a few patients, are suggestive of increased catabolism of protein in burned subjects. It has been well established by Williamson,[27] among others, that the amount of sulfates excreted in the urine is related to protein catabolism.

Although studies reported to date with labeled L-methionine have dealt exclusively with metabolism of plasma proteins, rather

than with the body protein as a whole, we feel that investigation of this facet reflects marked changes in tissue metabolism and serves as a base line for orientation with regard to the problem of protein derangements following thermal trauma. Work is going forward on our burn service with the use of labeled oral preparations (yeast), which we hope will be of assistance from an experimental standpoint in evaluating the efficacy of forced feeding regimens. Investigation with radioactive techniques is also being made in rats to correlate the data obtained from organ analysis with those from study of plasma protein changes.

Summary

Four groups of patients (normal hospitalized controls, nutritionally depleted patients, mild burns, and severe burns) are compared on the basis of curves obtained following intravenous administration of L-methionine labeled with S^{35}. Three components are identified: uptake, transfer, and apparent catabolic phases. Mathematical analysis of the die-away curve is presented.

No correlation was found between half-times of the initial transfer phase of newly synthesized protein from the intravascular to the extravascular compartment in normal and burned patients.

Burned patients were found to have either normal or increased rates of protein anabolism, as demonstrated by the amount of incorporation of the label into the serum proteins and by the amount of urinary excretion of radiosulfur.

In spite of individual variations, half-times of the apparent catabolic phase were found to be significantly shorter in the group of severely burned patients.

DeWayne Phillips rendered technical assistance.

Department of Surgery (Plastic and Maxillofacial), University of Texas Medical Branch (Dr. T. G. Blocker Jr.)

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A Study of Epithelization in Blistered Burns

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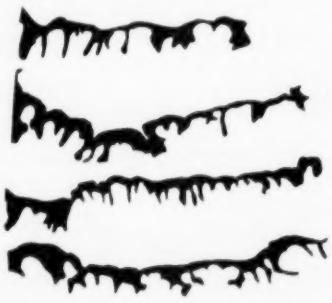
The surgeon responsible for the care of a blistered burn has three decisions to make. First, he may or may not undertake to cleanse foreign material from the burn. Second, he must decide what to do with the blisters. He may leave them intact[1]; he may aspirate the fluid,[2] or he may surgically unroof them.[3] Third, he may expose the burn to the air or in some manner elect to dress it. The experiments to be described were designed to discover such differences in epithelization as may depend upon whether the blisters are aspirated, unroofed, or allowed to remain intact.

Experiments

The subjects were medical student volunteers. With the area under lidocaine (Xylocaine) hydrochloride anesthesia, burn blisters were produced by contact with the end of a weighted copper cylinder, 1 cm. in diameter, through which water from a thermostatically controlled bath vigorously recirculated. Twelve to sixteen burns were made in a horizontal row just below the umbilicus. For protection from mechanical injury and to simulate clinical exposure management, the subjects wore stiff cardboard cradles taped to their skins and operating room suits with the shirts outside the pants. Aspiration of the blisters was performed at 24 hours and generally required repetition on the 2nd and 3d days because of reaccumulation of fluid. Blisters were unroofed with scissors; the exposed surfaces dried out some 48 hours later, generally with moderately high crusts. None of the burns showed clinical evidence of infection. At the conclusion of the experiment, a band of skin containing the burns was excised. Following formalin fixation, a median strip, 1 mm. wide, was cut so as to pass through the center of the burn and to include unburned skin on either side. Histologic sections were cut perpendicular to the surface, so as to show the radial profile of the regenerating epithelium. An image of the section was projected through the microscope, and the outline of the new epithelium traced on heavy paper (Fig. 1), which was cut out and weighed. This weight, divided by the weight of a square millimeter of paper, gives the paper area. This, in turn, may be used to calculate the mean thickness of the new epithelium; paper area ($mm.^2$) equals magnification^2 times epithelial distance (mm.) times mean epithelial thickness (mm.). As viewed in profile, the surface of much of the regenerating epithelium was irregular (Fig. 1), so that the linear distance from the edge of the burn to the advancing margin of epithelium was as much as 35% less than the distance as measured along the surface contour. It is the contour growth, measured with a plastic thread on the paper image, which appears in the Tables as "growth radius." However, the results and statistical significances of the study are the same, whether the figures for linear or contour distances are employed. In each case, the "growth radius" represents the mean of the two radiuses seen on the microscopic section.

Three studies comprising 40 burns were conducted. The first two were identical, and the results are grouped together. Each subject received 12 burns at 62 C, six with 20-second contact and six with 45-second contact. Two burns of each severity were aspirated; two were unroofed at 24 hours; and two were left intact. On the 5th day

Fig. 1.—Cutouts of four typical traced projections of regenerating epithelium.



Supported by a grant from the Detroit Receiving Hospital Research Corporation.

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

From the Departments of Surgery and Dermatology, Wayne State University College of Medicine and the Detroit Receiving Hospital.

TABLE 1.—*Five-Day Epithelization: Experiments 1 and 2*
(Growth Radius in Millimeters)

	20 Sec.—62 C	45 Sec.—62 C
Intact	2.4 1.4	1.7 1.1
Aspirated	1.2 1.1	1.1 0.5
Unroofed	1.2 1.0	1.3 0.6
Significance $\left[\frac{\bar{x}-\bar{y}}{S.E.}\right]$	1.46 (86%)	1.53 (87%)

six burns (one of each mode of treatment for each severity) were excised; the remaining six burns were excised on the 14th day. In the third study, 16 burns at 61 C with 45-second contact were made. Six blisters were left intact; five were unroofed at 24 hours; and five were unroofed at 48 hours. Eight burns were excised on the fifth day and eight on the eighth day.

Results

Table 1 shows the five-day epithelization that occurred under the three modes of

TABLE 2.—*Fourteen-Day Epithelization: Experiments 1 and 2*

	20 Sec.—62 C	45 Sec.—62 C
Intact	Healed Healed	Healed Healed
Aspirated	Healed Healed	Healed 0.7 mm. unhealed
Unroofed	Healed 2.0 mm. unhealed	0.4 mm. unhealed 4.4 mm. unhealed

treatment of the first two experiments. Growth appears to be more rapid when the blisters are left intact than when they are either aspirated or unroofed, but the difference is not statistically significant. Table 2 gives the measurements from the 14-day excision biopsy. The only group in which all burns are epithelized is that of the intact

TABLE 3.—*Epithelization: Experiment 3*
(Growth Radius in Millimeters; All Burns 45 Sec., 61 C)

Interval	Management	Mean	Range	S.E.	Significance $\left[\frac{\bar{x}-\bar{y}}{S.E.}\right]$
5 days	Intact (3)	1.4	1.3–1.5	0.09	4.37 (99.9%)
	Unroofed (5)	1.0	0.9–1.1	0.04	
8 days	Intact (3)	2.7	2.0–3.1	0.36	1.88 (94%)
	Unroofed (5)	2.0	1.6–2.4	0.14	

Fig. 2.—An unroofed blister that shows the greater thickness of the new epithelium near the junction with unburned skin; five days; × 90.

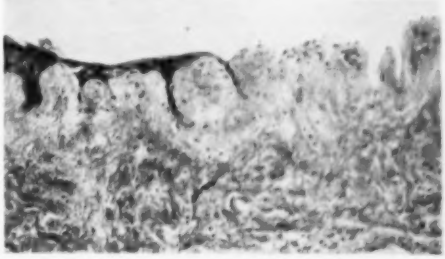
blisters. Table 3 summarizes the epithelization in the third experiment. There is no reasonable doubt but that covering is more rapid in the intact blisters than in the unroofed ones. No difference was noted between blisters unroofed at 24 hours and at 48 hours.

TABLE 4.—*Configuration of Epithelial Regeneration: Experiment 3*
(Mean Depth in Millimeters)

Interval	Peripheral, 0.5 Mm.	Central Growth	Ratio, Peripheral/Central
5 days	0.110	0.066	1.7
8 days	0.092	0.074	1.2

From inspection of the healing burns it is apparent that a relatively thick pad of epithelium forms at the periphery of the wound, while the central expansion is thinner (Fig. 2). This impression is borne out by the measurements given in Table 4. The peripheral massing is less prominent on the 8th day than on the 5th day; at the 14th day it is no longer apparent. No significant correlation was found between the mean thick-

Fig. 3.—Advancing edge of epithelium in an intact blister. Note the contour of the dermal papillae that lie ahead of the epithelium. × 120.



ness of the epithelial regeneration and the mode of therapy, although that found beneath the intact blisters tended to be thinner.

Comment

Blisters and Epithelization.—Although dermatologists deal with several forms of blistering within the epidermis itself, burn blisters represent a separation of the epidermis from the dermis. In burns of the mildness of these experiments, the dermal surface retains its normal configuration, which in profile (Figs. 2 and 3) resembles a washboard but seen from above [4] consists of a system of ridges, valleys, cones, and papillae. The regenerating epithelium cannot span from the apex of one dermal papilla to the next but follows the dermal contour. It clings to solid surfaces; furthermore, it will cover for a certain distance any solid surface, such as paper. If fibrin

Fig. 4A.—Intact blister, showing bifurcation of epithelium on encountering fibrin; × 30.

lies in its path, epithelium may split its stream, sending one column upward and the other beneath (Fig. 4), although it prefers dermis to fibrin as its footing.[5] It is obvious that for a surface-creeping, vine-like growth the physical characteristics of the terrain have great moment. Aside from the possible role of subclinical infection, we believe that the absence of mechanical barrier to the sliding in of the epithelial plate is the probable explanation for the more rapid covering when the blister is intact. When the regenerating epithelium must wedge off a coagulum of dried exudate bonded to the dermal surface (Fig. 5), the leading edge is generally thicker than when the dermis is naked in a fluid bath (Fig. 3). However, the contrast in surface between exposed and intact blisters is not so absolute as is perhaps implied, because dermal coating with a delicate,

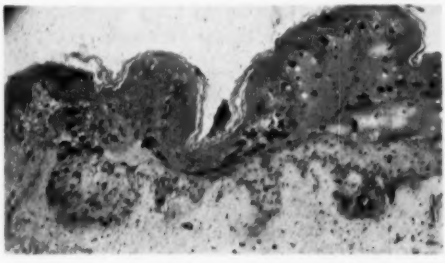
Fig. 4B.—Detail from section shown in Figure 4A; × 180.

areolar fibrin is found in some intact blisters. It also seems likely that the dermis is healthier when it is moist. All forms of collagen—tendon, periosteum, fascia—suffer from drought.

Clinical Implications.—It is not believed that this study has many implications for the management of clinical burns. Many blisters are already ruptured by the time the surgeon sees them: others are so large as to be mechanically unstable.

In no way does the study imply a conflict with the exposure management of burns. Indeed, large blisters can be kept intact only by refraining from dressing them. We commonly treat burns by the exposure method, leaving the blistered areas intact. If infection should develop beneath a blister, it is unroofed, just as is done for infection developing beneath a dry eschar. Exposed intact blisters (both clinical and experimental) go into negative water balance and collapse after 12 days or more. While

Fig. 5.—Advancing edge of epithelium in a crusted, unroofed blister. Not only is the edge thicker, but the individual cells are deeper and less pavement-like. × 120.



they continue to lose water to the atmosphere, they receive less by diffusion from the underlying dermis, as epithelium grows in beneath them. This balance is similar to that regulating the moisture content of the corneal layer of normal epidermis,[6] both being equally dead and equally dependent upon differential water diffusion rates to determine their degree of hydration.

It is important to realize that in more extensive and deeper partial thickness burns the method of healing is quite different. A slough of the superficial dermis takes place, and most of the new covering is derived from the skin appendages. In our small, shallow experimental burns, however, epithelization is from the margins. Furthermore, none of the dermis is cast off; the injured tissue is gradually reorganized only after it has received its epithelial covering.

Summary

Superficial blistered burns epithelize about 40% more rapidly when the blister is left intact than when it is unroofed. Blisters should not be disturbed, unless such a course is in conflict with the patient's more general interests. Insufficient experimental information was obtained to evaluate blister aspiration precisely.

Department of Surgery, College of Medicine, Wayne State University (7) (Dr. Gimbel)

Addendum

Additional experiments performed subsequent to the submission of this paper show that epithelization is less rapid in aspirated than in intact blisters, although not so slow as in unroofed ones.

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DISCUSSION

ON PAPERS BY DRS. T. G. BLOCKER JR., LEVIN, LEWIS, AND V. BLOCKER AND MR. PERRY AND BY DRS. GIMBEL, KAPETANSKY, WEISSMAN, AND PINKUS

DR. H. M. TRUSLER, Indianapolis: I arise primarily to ask Dr. Blocker a question and to commend both the essayists on these excellent papers. They are fundamental in the study of the ever important burn problem.

Dr. Blocker, were you able in any of your investigations to determine whether the burned patient was being poorly treated from the standpoint of maintenance of anabolic balance, and can you detect that by this research tool?

DR. T. G. BLOCKER JR., Galveston, Texas: The point of this study is to try to confirm objectively the conclusions which we have made from our clinical appraisal of the burned patient and also to support our hypothesis that the more one feeds a severely burned patient, after he is over the early shock phase, the more chance he will have to survive. We feel very definitely from a clinical standpoint that, after four or five days have elapsed and the burned patient is stabilized, forced feeding will result in a much smoother convalescence even in less critical cases.

With evidence pointing toward increased protein anabolism in the burned patient, we feel justified in continuing our program of hyperalimentation.

Postoperative Abdominal Muscle Spasm

W. KENNETH JENNINGS, M.D.; JOHN R. RYDELL, M.D., and HERBERT ZIMMERMANN, M.D.,
Santa Barbara, Calif.

Every laparotomy is followed by several days of discomfort, but postoperative pain varies greatly among patients. Such discomfort may include (1) ordinary abdominal wall pain due to cutting and retraction of nerves and muscles; (2) distention of the gastrointestinal tract because of ileus, an almost invariable accompaniment of intra-abdominal surgery, and (3) pain due to some internal postoperative complication or disease, such as bleeding, infection, or drainage. The purpose of this paper is to center attention on the problems associated with exaggerated parietal wall pain.

Description of Entity

A survey of the surgical literature has failed to reveal any specific description of postoperative abdominal muscle spasm. The condition is not that of the ordinary painful wound, but one characterized by agonizing spasms, usually in the rectus muscle. Initiated by bodily movements or reflex abdominal muscle contractions, these are of short duration, commonly lasting from a few seconds up to perhaps a half minute. But they are highly distressing to the patient and difficult for the physician to control. The onset is apt to come during the first 24 to 48 hours after operation, and the complication may be expected to recur for at least 2 or 3 days. Between the spasms the patient is comparatively free of distress.

It is true that minor degrees of muscle spasm after surgery are common and usually are not distinguished from the ordinary wound pain. If the patient is carefully questioned, however, the surgeon may discover that the wound is relatively pain-free except for these recurrent and momentary spasms of intense pain. We are sure they are frequently overlooked. In certain patients the muscle spasm here under discussion is of such frequency, length, and severity that the condition may be mistaken for peritonitis, so rigid and painful is the abdomen.

Even in health, most of us have experienced severe cramps in the muscles of the calf of the leg, usually during the night when the extremities are relaxed. A similar spasm may be suffered during the postoperative period in the rectus abdominis muscle, and this may occur without voluntary contraction or movement to initiate it. Occasionally these painful contractions may continue beyond the period of hospital confinement; indeed, one of our patients suffered spasmodic pain under the scar intermittently for almost a year. Many such persons undoubtedly have been labeled psychoneurotics.

Etiology

It seems reasonable to believe that postoperative muscle spasm is due to hyperirritability of the muscle. Certainly one factor contributing to its onset must be trauma due to cutting and retracting. Surgical assistants retracted just as forcibly, if not more so, in years gone by, when ether and spinal anesthesia were the anesthesiologist's only tools for effecting abdominal muscle relaxation. Yet, we are inclined to pose the question: Is not this entity increasing in incidence? We cannot believe that the surgeons of the past, particularly those eminent teachers who were obliged to depend upon their special senses for clinical diag-

From the Santa Barbara Cottage Hospital.

Read at the 64th Annual Meeting of the Western Surgical Association, Cincinnati, Nov. 30, 1956.

TABLE 1.—*Postoperative Muscle Spasm*
Questionnaire to Western Surgical Association (1956)

Replies received	147	
No. of positive replies	52	(35%)
No. having personally experienced spasm	4	

nosis, would have overlooked so dramatic a complication. And, if it is a new entity, why should it be appearing with increasing frequency? Our patients receive much the same preoperative medication, and the same suture materials are used, as in the preceding generation. Nor are modern incisions generally larger than they were in earlier years.

It is in the field of anesthesia that the outstanding changes of the past decade have occurred. Only recently have curare, succinylcholine (Anectine) chloride, and similar muscle-relaxing drugs been employed, and their use has now developed to the point where they are almost invariably administered to patients undergoing major surgery at some time during the operation. This may well prove to be a factor in the genesis of postoperative muscle spasm. When a muscle is drugged into complete relaxation, is it, we wonder, more irritable than normal upon its recovery? Hunnicutt [1] feels that most cases of this muscle spasm are due to an intercostal neuralgia and calls attention to the narrowing of the affected intercostal space as an important diagnostic sign. Certainly another factor is the temperament of the patient. The nervous, apprehensive, high-strung person is definitely more susceptible to the development of this complication.

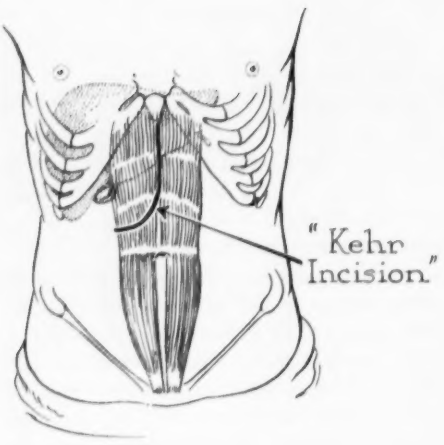
Comment

We have observed this problem in 11 private patients over the last three years. We are convinced that it is becoming more frequent, as we can recall seeing it only rarely in earlier years. A questionnaire was sent (Table 1) to the members of the Western Surgical Association, and 147 replies were received from them. Of these, 52 (35%) indicated that they were definitely aware of the problem and had observed the complication in their patients. Four members stated that they had suffered these painful spasms in their own wounds after surgery and knew only too well the resulting misery. Statistics concerning the cases recorded are difficult to evaluate, owing to the fact that the pain noted ranges through gradations of severity from the most excruciating down to those so slight as scarcely to exceed what may be called normal wound pain. Yet it is estimated that well over 100 cases, of sufficient severity to constitute a troublesome problem, were recognized last year by members of the Western Surgical Association. Fortunately, nearly all spasms have subsided by the time the sutures have been removed.

In our own series (Table 2), the patients were eight men and three women, and 8 of the 11 incisions were for upper abdominal surgery (4 cholecystectomies, 4 gastric resections, 2 resections of sigmoid for carcinoma, and 1 appendectomy for ruptured appendix). These patients were, as a group, not obese and were in the usual distribution of age range. But most of them were tense and definitely more nervous than the aver-

TABLE 2.—*Postoperative Muscle Spasm*

	Sex	Age, Yr.	Operation	Incision	Habitus
1953	F	71	GB	Paramedian	Average
	M	39	GR-DU	Paramedian	Thin
	M	77	GB	Kehr	Stout
1954	M	64	Ca sigmoid	Paramedian	Thin
	M	74	GB	Paramedian	Thin
	M	37	Appendix	Paramedian	Average
1955	M	61	GR-DU	Paramedian	Thin
	M	51	GR-DU	Kehr	Thin
	M	64	GB	Kehr	Average
	F	40	GR-DU	Kehr	Thin
	F	57	Ca sigmoid	Paramedian	Average



age, both before and after surgery; this was especially true of the four duodenal ulcer cases. Retention sutures were not used in any of these operations, although other surgeons have felt that through-and-through sutures might predispose to painful spasms. In recent years we have tended to favor the Kehr incision (Fig.) for upper abdominal surgery, believing that it combines certain advantages of both the upper midline and the rectus-splitting incisions. Unfortunately the Kehr incision has been associated with as high an incidence of wound spasm as has the ordinary vertical rectus incision (Table 3). We have yet to encounter our first case of severe spasm after a subcostal or a true midline incision, despite not infrequent use of the latter. Others, however, have reported to us occasional instances of this complication after subcostal and midline incisions.

Treatment

Certain therapeutic measures are helpful to some patients, yet not to others. Until the cause is better understood, a specific treatment for the condition is not likely to be found. Unfortunately, in a severe case the degree of pain is so distressing that large doses of narcotics are ineffectual in controlling it. A patient may be made quite somnolent by narcotics and yet cry out with pain when the spasm strikes, for it can be a pain at least as severe as renal colic. These postoperative rectus spasms are often successfully controlled by local procaine injections into the incision. Blades [2] has described his technique of controlling postoperative pain by injecting procaine through small polyethylene catheters every few hours during the first days after surgery. This has proved helpful in decreasing the number of postoperative narcotic injections.

Sometimes regional nerve block will serve just as well. Much work has been done on the problem of bilateral intercostal nerve block for attempted relief of postoperative pain. As far back as 1940, Bartlett [3] performed such injection to make surgery safer in seriously ill or markedly debilitated patients. In 1941 he began using long-acting anesthetic agents for intercostal block to reduce wound pain and thereby diminish postoperative pulmonary complications. In earlier years the oil in the solutions did not permit ready diffusion, so that the abdominal wall anesthesia was spotty and the results were inconstant. But in 1952 Bartlett [4] reported more encouraging results with the use of a long-acting local anesthetic agent, Efocaine. Most of his patients treated in this manner did not require opiates postoperatively; however, no mention was made of the muscle spasm which we have here described.

Zollinger [5] has also been interested in this problem for many years and reported some success with it in 1941. In 1948 [6] he was advocating the use of dibucaine (Nupercaine) hydrochloride in oil for intercostal nerve block after upper abdominal surgery

TABLE 3.—*Postoperative Muscle Spasm*
Type of Incision

	No. of Cases	Cases of Spasm	Per Cent
Rectus split	149	7	4.7
Kehr	56	4	7.1
	205	11	5.4
Midline	55	0	0
Subcostal	51	0	0
	106	0	0

and found that by this method there was a marked reduction in narcotic requirements and in pulmonary complications. Priestley [7] in 1949 studied the intercostal injection of an ammonium sulfate solution, Dolamin, for prolonged relief of postoperative pain but was dissatisfied with the degree of effectiveness of this drug. He currently states that he is troubled by this problem of postoperative severe wound spasm several times each year. Hunnicutt [1] has reported a case in which complete relief followed an injection of lidocaine (Xylocaine) hydrochloride into the 11th intercostal space; severe spasmodic pain had been experienced in the right lower quadrant after appendectomy.

In our own efforts to control such spasms, we do not hesitate to perform repeated procaine injections. Intravenously administered procaine and intravenously administered alcohol have also been tried with some success, but the degree of relief does not seem to be as great as that after local or regional procaine injections. Quinine has enjoyed popularity for a great number of years as an agent to control muscle spasms. From this, others have reported hopeful results, but we have had no experience with its use. It has been suggested that in certain patients the pain may be related to an excessively low serum sodium, similar to that seen in heat cramps. For such patients the administration of sodium chloride intravenously should be specific.

Chlorpromazine (Thorazine) hydrochloride has been widely used to help control discomfort in the postoperative period, and we have the impression that it is more effective in relieving the pain of spasms than are narcotics. For this, probably the dosage should be large. Curare would theoretically be an ideal agent for dealing with this condition, as it relaxes skeletal muscle, but, since it is difficult to administer with safety over prolonged periods, we have avoided its use. Moreover, there is the possibility that it may even contribute to the production of muscle spasms by causing muscle irritability in the postanesthetic period.

In the prevention of the complications we are discussing, gentleness during surgery should help. Rough retraction, too tight retention sutures, and a long rectus-splitting incision are all to be avoided. Of course, drainage of any abscess or hematoma may clear up an occasional case of spasm due to irritation from the fluid collection. The surgeon can give further help by his advice. We recommend to our patients that they avoid sudden turns or motions involving the abdominal muscles. We tell them that the spasms, admittedly very painful, are nearly always of short duration and do not indicate any more serious complications. Such reassurance is an important part of the treatment.

Summary and Conclusions

Postoperative abdominal muscle spasm is a definite entity, and it seems to be occurring with increasing frequency.

Its exact cause is unknown, but it may be influenced by trauma during surgery, by the increasing use of muscle-relaxing drugs, and by a high-strung, nervous, apprehensive temperament.

In our experience its frequency is three times greater in male patients.

It occurs predominantly in upper abdominal incisions and particularly with the Kehr or the vertical rectus-splitting incisions.

Various treatments have been suggested. It is important to reassure the patient that the spasms are self-limited in duration and not indicative of other more serious complications.

Repeated procaine injections are the most useful treatment to relieve abdominal muscle spasms.

233 W. Pueblo St.

DISCUSSION

DR. HOWARD D. COGSWELL, Tucson, Ariz.: I possibly would have listened to this paper with a good deal of skepticism if I had not had the unhappy experience of seeing some of my own patients manifest this syndrome. I have had two cases very recently which make me appreciate hearing this discussion all the more. I cannot

recall seeing a similar postoperative reaction before the past few years, making me believe that this type of postoperative pain must be secondary to something that has been changed or added in the surgical procedures, including anesthesia. Since our surgical technique has varied very little, it may be important that those patients who have manifested this reaction have all had curare-like drugs during anesthesia. The last two patients had right subcostal incisions in conjunction with a cholecystectomy. The severe pain, which appeared to be associated with right rectus muscle spasm, could be initiated by the patient's moving or taking deep breaths, and even removing the tape and dressings could initiate an episode. The discomfort was of such severity that opiates did not relieve the painful spasm. With the shallow, guarded respirations, I was concerned with the possibility of an atelectasis developing. One of the patients was a physician friend of mine, and I was concerned for a short time that his unrelieved paroxysms of pain would end a beautiful friendship.

Dr. JOHN McM. WAUGH, Rochester, Minn.: I should just like to emphasize that this condition does occur. It is very painful. I have not seen it after transverse incisions or subcostal incisions or midline incisions, but I have observed it on several occasions after rectus, both retracting and muscle-splitting, incisions.

I think that it is a complication that is very easy to overlook unless it occurs in yourself or in one of your good friends or happens to appear at the exact time you are at the patient's bedside on postoperative rounds.

Dr. W. KENNETH JENNINGS, Santa Barbara, Calif.: I should just like to say that if there is anything of value in this paper it is largely due to the generous response of the members of this Association to the questionnaire which we sent out.

We were naturally pleased that 52 reported having observed and recognized this as an unmistakable complication and that several regarded it as a serious postoperative problem.

We received two rather lengthy communications from Arthur Hunnicutt, of Oakland, Calif., whose comments and suggestions were so carefully documented that for a time I thought we might substitute them for the paper. We were particularly interested to learn that four of our members have personally experienced these intermittent postoperative abdominal spasms.

We believe that this is a definite entity and that it is increasing in frequency, and we therefore thought it important enough to bring it to your attention.

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Air Evacuation of Maxillofacial Injuries

MAJOR LUCIAN SZMYD (DC), U.S.A.F.

Maxillofacial injuries are among those most frequently sustained by military personnel. The air evacuation of patients with facial trauma is, therefore, an important aspect of military aviation medicine and one requiring special consideration. In the latter part of World War II this type of casualty received top priority in the selection of patients for air evacuation.[1] Advancements in the concept of aerial transportation of maxillofacial injuries have evolved from extensive research on motion sickness, mechanical phases of air transportation, and physiological factors in flight. Experiences during World War II and the Korean conflict have demonstrated the value of the following three important measures in the air evacuation of facial trauma cases[2-7]: (1) early temporary stabilization; (2) control of motion sickness, and (3) quick release mechanisms of jaw fixation.

Early temporary stabilization of maxillofacial injuries facilitates the procedures incident to evacuation of the patient for definitive treatment, so that they can be carried out more expeditiously and with less resultant trauma. Furthermore, early temporary stabilization of facial fractures has vital therapeutic implications. This immobilization of the fractured elements will aid in controlling shock, infection, pain, swelling, trismus, and hemorrhage. Early temporary stabilization simplifies feeding, improves morale, and reduces the need for nursing care. It has a direct bearing upon the reestablishment of normal function of the masticatory apparatus and on the aesthetic result. Chipps and associates,[2] on the basis of 1000 maxillofacial fractures, stressed the therapeutic value of rendering treatment within the first 24 hours after facial trauma. They contended that the general alignment and moderate immobilization of fractures, so important to successful treatment of maxillofacial injuries, could be accomplished without resorting to complicated fixation techniques.

Since many cases of maxillofacial trauma are not seen by a dental officer until they arrive at a major treatment center, the medical officer is charged with the responsibility of accomplishing early temporary stabilization. The method of choice in attaining temporary stabilization by the medical officer consists of a simplified technique of intermaxillary fixation supplemented by a head bandage for support of the mandible. In maxillary fractures, the intact mandible is used as a splint against which the elements of the maxilla are repositioned and immobilized. In mandibular fractures, the intact maxilla is used as the splint. Although intermaxillary wiring may be accomplished without the use of an anesthetic, local anesthesia may facilitate the procedure. Stainless-steel wire of approximately 0.02 in. diameter (26 gauge) is ideal. A minimum of two posterior teeth in each quadrant are selected for wiring. Each of these teeth should be firm and have an opponent in the opposite arch, i. e., the biting surface of the upper tooth that is selected for wiring should contact that of the wired lower tooth when the jaws are brought together.

The combined wiring-head bandage technique recommended for medical officers is carried out as follows:

1. Pass a 2-in. length of wire around the neck of a tooth which has been selected for wiring (Fig. 1*1*).

2. Twist tightly with a hemostat to prevent the wire from slipping over the crown.

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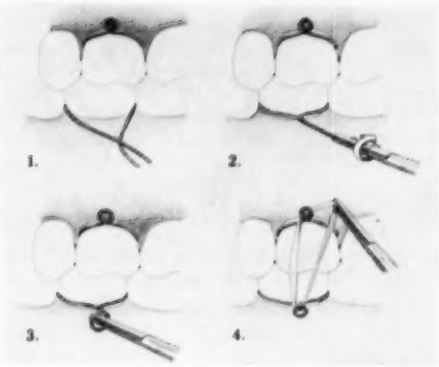


Fig. 1.—Simplified wiring technique for early temporary stabilization.

3. Twist the free ends completely (Fig. 12).

4. Cut the twisted wire ½-in. from the tooth.

5. Form a tight loop with the twisted end (Fig. 13).

6. Adapt this loop against the gingiva.

7. Form similar loops on all the teeth selected for wiring.

8. Anchor small intermaxillary elastic bands on these curved loops, so that the forces tend to bring the upper and lower jaws together (Fig. 14). (Elastic loops may be cut from pipette tubing.)

9. Apply the supplemental bandage (Fig. 2).

If armamentarium limitation precludes stabilization by intermaxillary traction, a head bandage alone may be employed. Although the head bandage is less effective when compared to intermaxillary elastic traction, it is of benefit in providing gross stabilization, especially in instances where both the maxilla and the mandible are fractured.

Air Force regulations state, "The following are not normally acceptable for air transportation—patients with permanently fixed tie-wires between the jaws."[8] The regulations emphasize a basic problem in the evacuation of oral fracture patients, which stems from the fact that the jaws are immobilized. The patient may experience serious respiratory difficulties resulting from aspiration of vomitus incident to motion sickness. Almost everyone can be made sick when the intensity, duration, and nature of the motion are adequate.[9] On the other hand, a patient is more susceptible to air sickness than is a well person.[10]

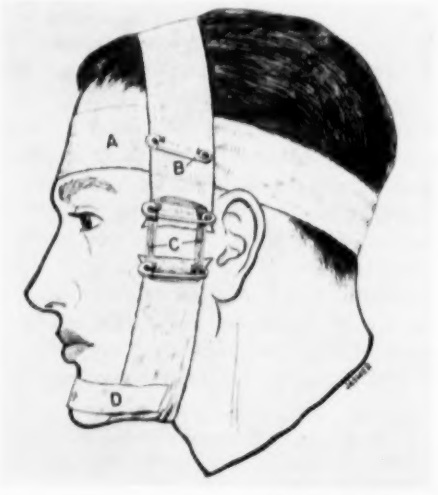
The flight surgeon's thorough evaluation and preparation of the maxillofacial patient for evacuation, as well as a consideration of the physical and physiological aspects of flight, greatly reduce the incidence of motion sickness. In this regard, the following therapeutic measures are instituted by the flight surgeon in the evacuation of maxillofacial injuries:

1. A short indoctrination talk is given prior to take-off in order to alleviate any apprehension or fear of flying.[11-13]

2. The patients are questioned regarding their susceptibility to motion sickness. The medical flight personnel are provided this information, since it is reliable in predicting the probable incidence of airsickness.[14]

3. Preflight lavatory hygiene is recommended in order to prevent the accumulation of gas in the bowel. This gas expands at altitude and may cause marked distention of the duodenum.[15]

Fig. 2.—Head bandage for temporary stabilization. *A*, gauze bandage; *B*, safety pin; *C*, rubber bands; *D*, adhesive tape. (The use of rubber bands [*C*] will not preclude opening the mouth in the event of motion sickness.)



4. The amount of the so-called "gas-forming foods," such as carbohydrates, milk, and carbonated drinks, utilized in the patient's fracture diet is restricted.

5. Delay in the evacuation of the patient with intermaxillary fixation is considered whenever turbulence is forecast.[16]

6. Mechanical suction and other equipment, such as an emergency tracheotomy set, are provided for the flight. Effective therapeutic measures, such as elective tracheostomy and Levin tube feeding for the maintenance of airway, hydration, and balanced diet, are also evaluated.

7. The patient is placed in a location over the wing where the ride is smoothest. The supine position reduces airsickness by abolishing the excitation of the utriculus.[17] However, the prone or lateral position is used when any respiratory difficulties are anticipated.

8. The patient is placed low in the litter block, so that he is readily accessible to the medical flight personnel.

9. The patient is placed in a position favorable for swallowing during in-flight meals. The decreased air density at altitude reduces the effectiveness of the cough mechanism and may result in prolonged efforts to clear the respiratory passage should a small amount of food be inadvertently aspirated.[18]

10. The following drugs effective against motion sickness are administered orally or parenterally: meclizine (Bonamine) hydrochloride; diphenhydramine (Benadryl) hydrochloride; cyclizine (Marezine) hydrochloride; promethazine (Phenergan) hydrochloride, or dimenhydrinate (Dramamine).[14,19-22]

The development of airsickness in one individual has an infectious reaction on the other passengers and will frequently be followed by their sudden illness.[1] Therapeutic measures are instituted when symptoms of drowsiness, pallor, cold sweating, and nausea, which usually precede vomiting, are observed by the medical flight personnel. Loosening tight belts, massage of the abdomen, adjustment of pillows to minimize lateral head motion, requesting the patient to keep eyes closed, mild medication, reassurance, and use of oxygen during flight are simple but effective procedures to alleviate symptoms of airsickness.[23-25]

Occasionally the flight surgeon finds that fixation of maxillofacial injuries has been accomplished by utilizing wires between the maxilla and the mandible rather than elastic bands. In order to comply with Air Force regulations, it has been the policy not to transport those patients with permanently fixed intermaxillary wiring unless the "tie-wires" between the jaws were removed during flight or replaced by elastics.[26] However, the removal of intermaxillary "tie-wires" in order to transport maxillofacial injuries jeopardizes the integrity of the mandible and may lead to serious complications. In cases of extensive bilateral fractures of the mandible, the upward and inward pull of the elevator muscles and the downward and backward pull of the depressor muscles on the fractured elements may disrupt the continuity of the fractured elements. Even though the basic wiring on either the maxilla or the mandible is not disturbed, the loss of bony support by the tongue and soft tissue in the floor of the mouth will result in serious respiratory embarrassment.

The removal of intermaxillary "tie-wires" during flight may also adversely affect the healing process at the fracture sites because of muscle pull on the fractured elements. Furthermore, subsequent manipulation in order to realign the disturbed fractured elements may precipitate a breakdown of the external wound.

Although the replacement of permanently fixed "tie-wires" by elastics is an acceptable procedure in order that a maxillofacial patient may be transported by air, institution of the following precautionary measures is recommended:

1. One "tie-wire" is cut at a time and replaced immediately by an elastic. When all the "tie-wires" are cut simultaneously, a sudden disturbance of occlusion may be effected by muscle pull on the unsupported fractured elements.

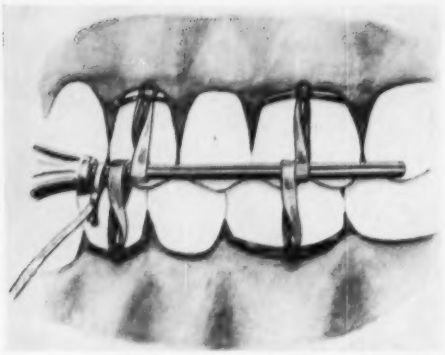


Fig. 3.—Modified "Cotter-Key" technique for quick release of intermaxillary jaw fixation.

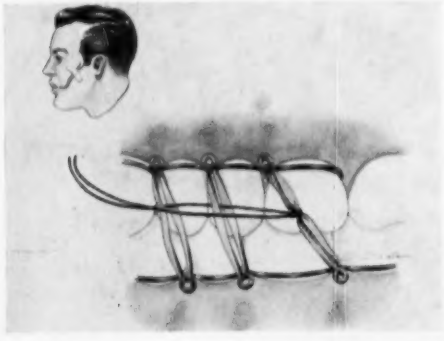
2. A pair of scissors suitable for cutting elastics is placed around the neck of the patient. Both the patient and the medical flight personnel are instructed as to the utilization of these scissors in releasing the jaws.

3. A quick release mechanism of jaw fixation which can be activated by the patient or attendant is provided. This procedure is carried out as follows (Fig. 3).

(a) Blunt the point of a 15-gauge needle (coat-hanger wire serves as a suitable substitute); *(b)* attach a small elastic band to an intramaxillary loop, and pass the needle through the band; *(c)* repeat this procedure for alternate loops of the maxillary and mandibular arches, and *(d)* tie a cord to the needle or wire to facilitate its rapid removal.

An alternate technique is carried out as follows (Fig. 4): *(a)* Pass a cord through the lumen of each intermaxillary elastic band, and *(b)* tape the free end of the cord to the patient's cheek.

Fig. 4.—"Rip cord" technique for quick release of intermaxillary jaw fixation.



Summary and Conclusions

Extensive research in the areas of motion sickness, mechanical phases of air transportation, and physiological factors in flight has brought about advancements in the techniques of air evacuation of maxillofacial injuries.

Early temporary stabilization in facial trauma cases has vital therapeutic implications. A combined wiring-head bandage technique recommended for medical officers is presented.

The prophylactic measures instituted by the flight surgeon to reduce the incidence of motion sickness include dietary control, psychotherapy, and the use of drugs.

The hazards of indiscriminate removal of intermaxillary fixation in order to transport maxillofacial cases are pointed out. Two simple but effective quick release mechanisms of jaw fixation are described and illustrated.

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Surgery Illustrated

Ileostomy and Subtotal Colectomy

JOHN L. MADDEN, M.D., New York

Comment

Ileostomy and Subtotal Colectomy

Clarence Dennis, M.D., Brooklyn

In reference to *A*, if the ileostomy is made precisely in the belt line and in the midportion of the belly of the right rectus muscle, the intact skin around it provides a smooth and slightly convex flexible surface for the later adhesion of an ileostomy bag. It is wise to note the position of the transverse creases which form across the abdomen when the patient bends over. These creases should be avoided in placing the ileostomy, for they make secure cementing of an ileostomy bag impossible.

In my first twenty-odd colectomies, careful preservation of the omentum (*C*) was followed by distressing evidences of adhesive obstruction in a considerable share of the cases. Since that time the omentum has been completely removed

(*Comment continued on page 816*)

PLATE I

A, the sites of the ileostomy stoma in the right lower quadrant and the left paramedian, muscle-splitting incision are depicted in dotted outline.

B, the peritoneal cavity is entered, and the wound margins are retracted to expose the subjacent viscera.

C, manual traction is maintained upward on the omentum and downward on the transverse colon as the relatively avascular attachments of the omentum to the colon are separated by scalpel dissection.

D, upon completion of the detachment of the omentum, the transverse colon is mobilized and the lesser peritoneal sac is entered.

E, the ascending colon is manually retracted toward the midline, and the mobilization of the right side of the colon is commenced by scissor dissection along the "white line," the fascia-fusion layer of Toldt.

This article is the third of four based on "Atlas of Technics in Surgery" by Dr. Madden, to be published in September, 1957, by Appleton-Century-Crofts, New York.

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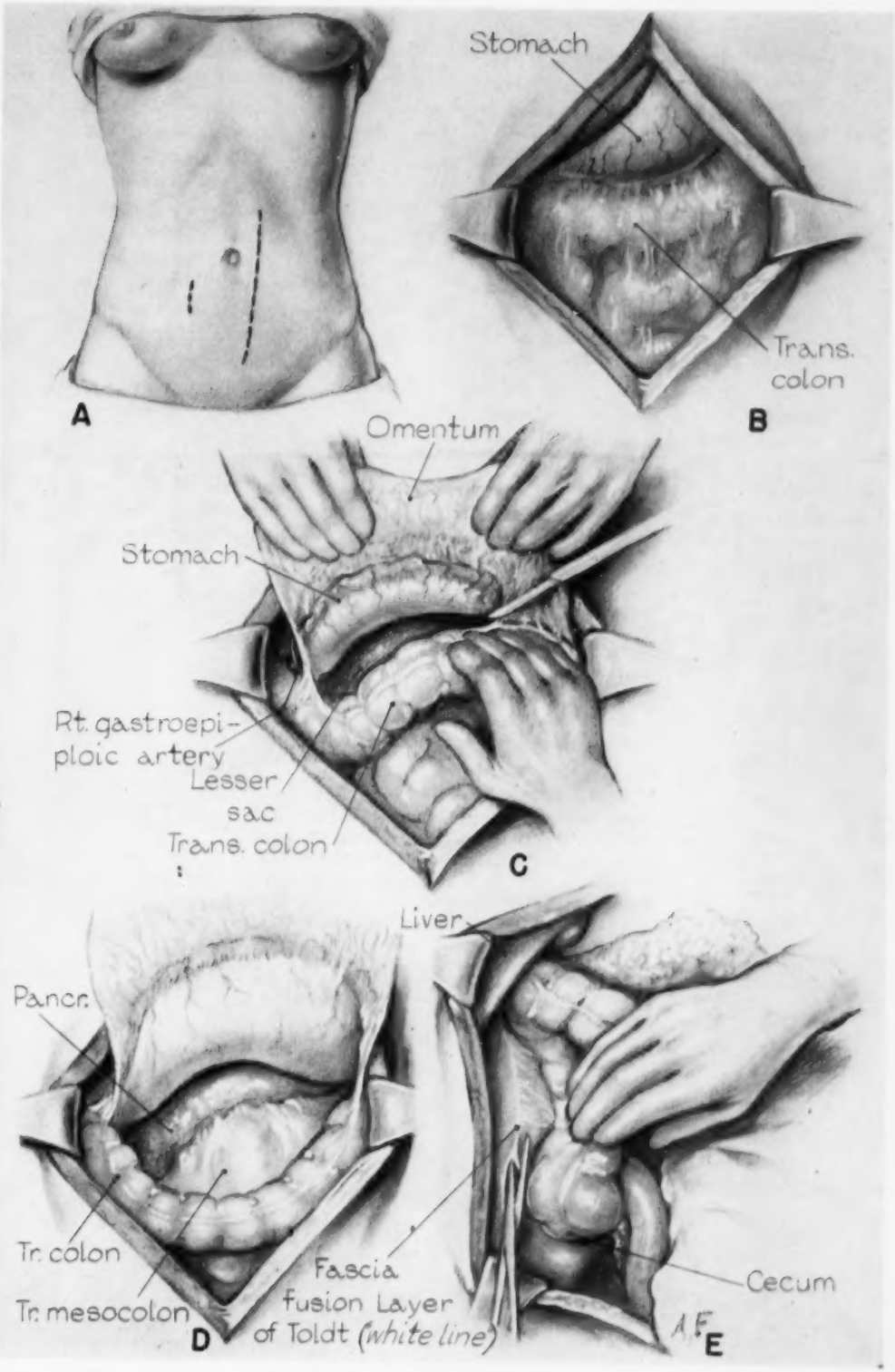

A
Stomach
Trans. colon
B
Omentum
Stomach
Rt. gastroepi-ploic artery
Lesser sac
Trans. colon
C
Liver
Panc.
Tr. colon
Tr. mesocolon
D
Fascia fusion Layer of Toldt (white line)
Cecum
A.F.
E

routinely with the specimen, and gratifying freedom from such complications has been observed. This experience covers a total of more than 100 colectomies.

It is usually preferable to commence the intra-abdominal dissection by freeing the cecum and ascending colon (*E*) together with the very terminal ileum. The reason for this move is that it is not possible to determine the exact level of invasion of the inflammatory process into the terminal ileum by gross examination of either the serosal or the mucosal surfaces. Since it is of paramount importance that the ileostomy be fashioned from the lowest normal segment of ileum, it is worth while to remove a short segment of the lowest area of the terminal ileum which appears normal and have rapid frozen sections prepared. The further dissection in the abdomen can be pursued while the pathologist is examining the specimen. Cellular infiltration of the submucosa or muscularis is an indication that the segment under consideration is involved with the process and that it would be wise to resect a few centimeters more of the terminal ileum with the specimen. The precise level at which the ileostomy is to be made is of extreme importance in the subsequent maintenance of satisfactory water balance because the lowest portion of the terminal ileum is extremely important in water reabsorption. Furthermore, the utilization of inflamed intestine to make an ileostomy is productive of a high incidence of late ileostomy complications. It is, therefore, essential to control the level of division by the study of rapid frozen section preparations of excised portions of the terminal ileum.

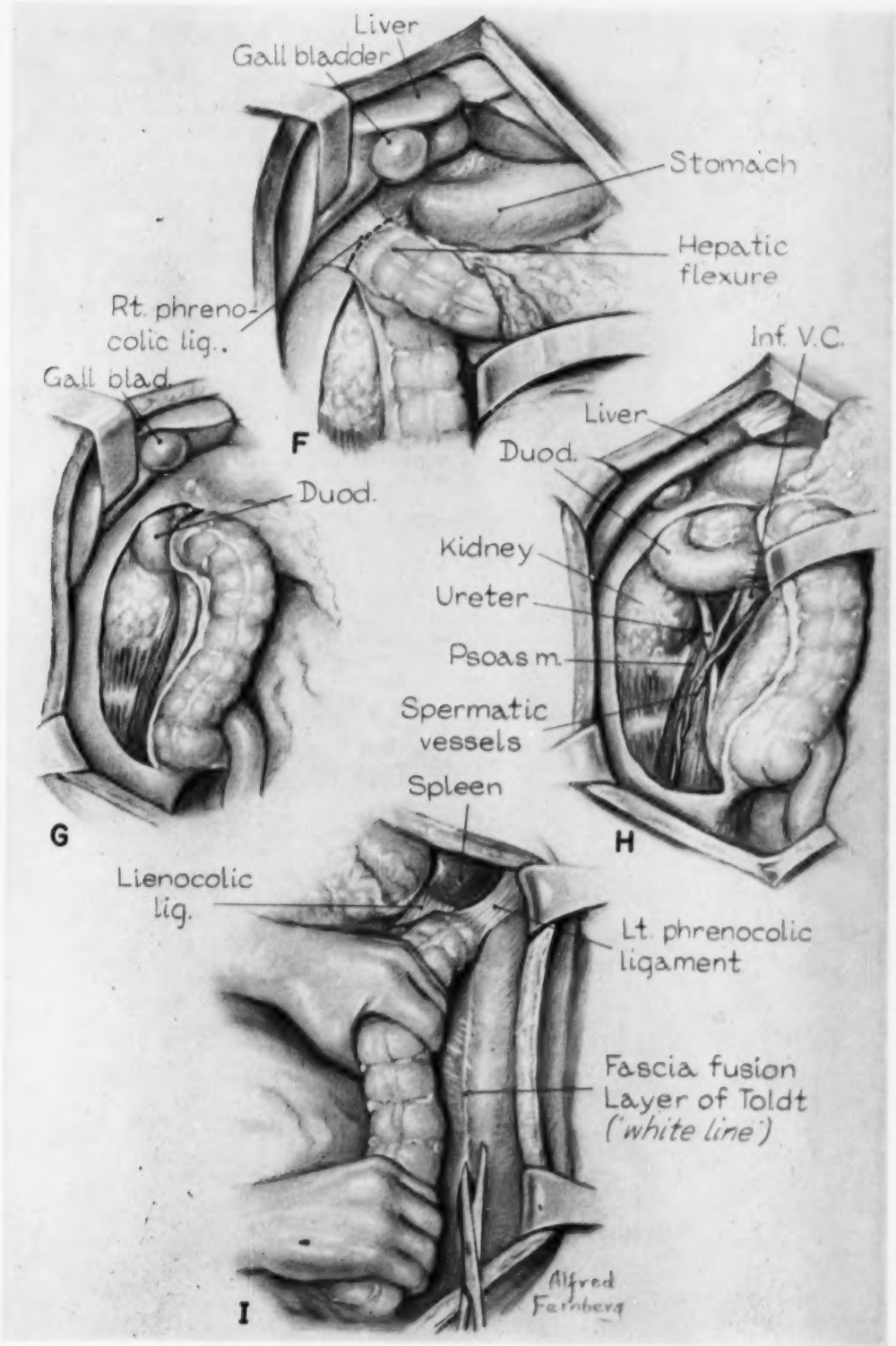
(*Comment continued on page 818*)

PLATE II

F, the hepatic flexure of the colon is mobilized by severance of the right phrenocolic ligament (dotted outline) and the retroperitoneal portion of the duodenum is exposed (*G*).

H, the right side of the colon, completely mobilized, is rotated toward the midline, and the related structures in the retroperitoneal area are visible. In this mobilization one must be careful to avoid injury to the spermatic or ovarian vessels, the right ureter, the inferior vena cava, and the retrocolic portion of the duodenum.

I, the descending colon is manually retracted toward the midline and its mobilization, similar to that on the right side, is commenced by scissor dissection along the fascia-fusion layer of Toldt ("white line").


Liver
Gall bladder
Stomach
Hepatic flexure
Rt. phreno-colic lig..
Gall blad.
F
Inf. V.C.
Liver
Duod.
Duod.
Kidney
Ureter
Psoas m.
Spermatic vessels
Spleen
G
H
Lienocolic lig.
Lt. phrenocolic ligament
Fascia fusion
Layer of Toldt
('white line')
Alfred Fairbairn
I

A smoother surface of skin about the ileostomy can be achieved if one utilizes a circular incision rather than the simple longitudinal one illustrated (*P*). The circular incision is very satisfactory if made essentially as one would achieve if he made it with a cork-borer. The hemostasis must be meticulous, and the burial of suture material in the substance of the abdominal wall at this point should be minimized. Very fine gut, or still better, the utilization of the coagulation current in very meticulous fashion is worth while. It is my preference to preserve as much of the mesentery of the resected terminal ileum as possible and to have the mesenteric margin of the terminal ileum directed laterally rather than cephalad as shown (*R*). The purpose of saving this mesentery is to simplify the construction of a complete diaphragm bounded by the anterior, lateral, and posterior abdominal walls and the segment of ileum forming the ileostomy. Only by the meticulous closure of the defect lateral to the ileostomy may one be assured that whole segments of the intestinal tract do not wrap around this segment and cause a strangulating intestinal obstruction. In my experience this happened six times prior to the construction of a hemidiaphragm as described.

(*Comment continued on page 820*)

PLATE III

J, the mobilized descending colon is displaced medially, and the left phrenocolic ligament is severed. The mobilization of the left side of the colon is completed after severance of the lienocolic ligament as indicated in dotted outline.

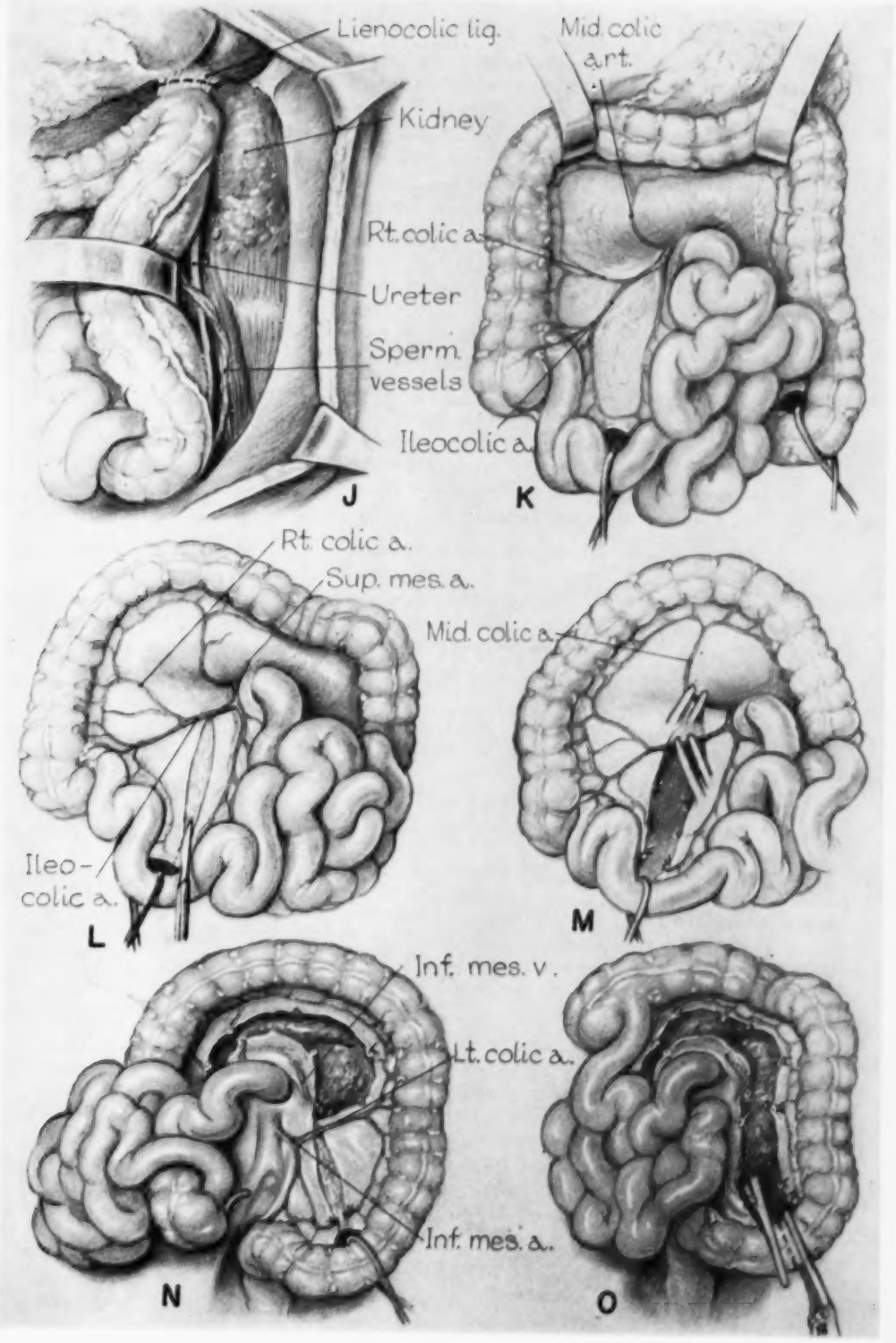
K, the vascular pattern of the right side of the colon is demonstrated, and the sites for division of the terminal ileum and the sigmoid colon are encircled by traction tapes of rubber tissue.

L, an incision is made through the serosal covering of the mesentery of the terminal ileum as a guide tract for the serial clamping and division of the mesentery.

M, the division of the mesentery of the terminal ileum is completed, and the clamps are applied to the ileocolic and middle colic branches of the superior mesenteric artery prior to their severance.

N, the severance of the mesenteric vascular attachment to the colon is completed to the left colic artery, the first branch of the inferior mesenteric artery. The guide tract for the division of the mesentery of the sigmoid colon and its contained left colic artery is depicted.

O, the sigmoid colon is doubly clamped at the junction of its middle and lower thirds and divided as indicated in dotted outline. The handle of the distal clamp is directed toward the center of the abdomen to facilitate its support when the wound dressing is applied.


Lienocolic lig.
Kidney
Rt. colic a.
Ureter
Sperm. vessels
Ileocolic a.
J
Mid. colic art.
K
Rt. colic a.
Sup. mes. a.
Ileo-colic a.
L
Mid. colic a.
M
Inf. mes. v.
Lt. colic a.
Inf. mes. a.
N
O

The incidence of late hernia formation or stenosis or prolapse of the ileostomy can be markedly reduced by the meticulous suture of the ileum to the posterior rectus sheath and peritoneum as it passes through the abdominal wall. For this purpose my preference is to use 0000 silk sutures and about 15 in number. The proper placement of these sutures is most important. The bite upon the peritoneal surface of the ileum must be precisely parallel to the one in the posterior rectus sheath and peritoneum. The suture must not penetrate into the mucosa, and it must not be tied tightly enough to cause strangulation. Although I have seen three instances in which fistulas formed about such sutures placed at the time of ileostomy, I personally have had none in the performance of over 125 ileostomies with the placement of sutures as described. Furthermore, in this series prolapse did not occur in any case in which the ileum was normal at the level at which the ileostomy was performed.

In the early cases in the series in which operation was performed at the University of Minnesota, the parietal reperitonization was performed similarly to that indicated (*S*) but the incidence of complications was high. In the last 100+ cases this reperitonization has not been done in either the right or the left gutter and no drains have been used. There has been no recognized complication from pursuit of this course.

In patients who are critically ill, it is appropriate to bring out the distal segment of colon through the bottom end of the abdominal incision (*T*). The frequency of retrograde purulent drainage onto the abdominal wall and the secondary pyoderma were distressing enough to lead to the decision to remove the rectum at the time of the total colectomy in those patients who were not too ill to have the two operations completed in one stage. It is my personal preference to utilize

(*Comment continued on page 822*)

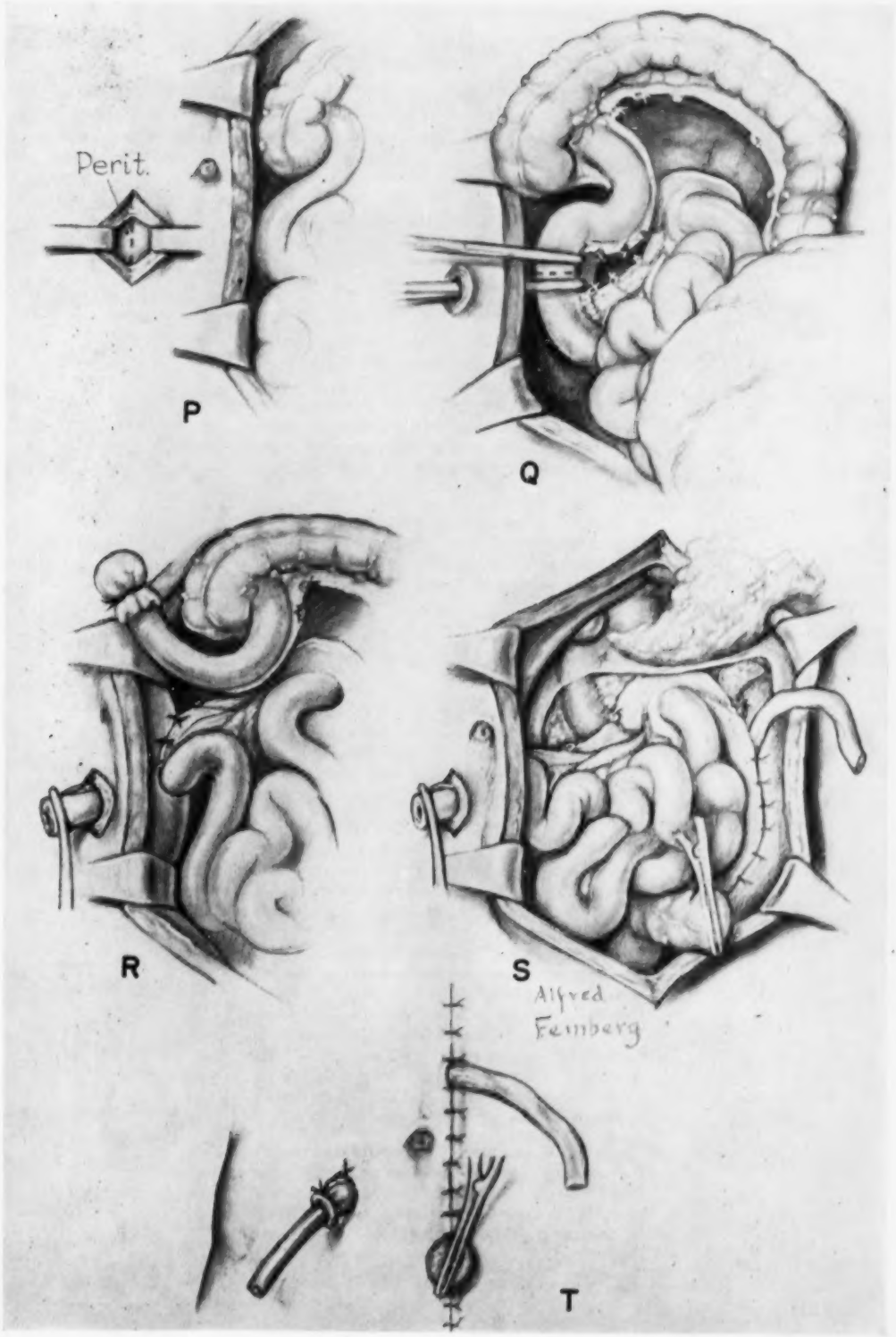
PLATE IV

P,Q, through a small incision, to the right and below the umbilicus, a clamp is applied to the proximal portion of the distal segment of the ileum. A second clamp is applied through the laparotomy incision to the ileum immediately distal to the first, and the ileum is severed between the clamps.

R, the distal cut end of the ileum is covered with a rubber diaphragm, and the proximal cut end is brought out through the small incision to the right of and below the umbilicus. To lessen the tendency toward mucosal prolapse of the ileum, the cut margin of the ileal mesentery is sutured to the anterior parietal peritoneum.

S, the operative field following completion of the operation is shown. A partial reperitonization is performed, and a drain is inserted into the retroperitoneal area. Prior to closure of the incision, the omentum is replaced over the small intestines.

T, the wound closure is completed about the retroperitoneal drain and the terminal portion of the sigmoid colon. To minimize the incidence of fistula formation, no sutures are used to anchor the ileum to any portion of the abdominal wall. A tube is secured in the lumen of the ileum to permit escape of the ileal contents into a bedside receptacle. The tube is ejected spontaneously between the fifth and seventh days when the retaining necrosing ligature sloughs through.


Perit.
P
Q
R
S
Alfred
Fernberg
T

the technique of B. N. Brooke, of Birmingham, England, (Plate V*F*) and to evert the ileum routinely so as not to leave any uncovered serosa exposed to drainage from the terminal ileum. In those cases in which the level of the ileostomy has been carefully controlled by rapid frozen section studies and this technique employed, the passage of formed stools within the first four or five days is usually observed.

(*Comment continued on page 824*)

PLATE V

This plate illustrates the combination of four procedures suggested by Garlock to prevent ileal dysfunction. During the past two years all or several of the methods illustrated have been used with excellent results. Accordingly, this is now the preferred technique in the establishment of the ileostomy stoma.

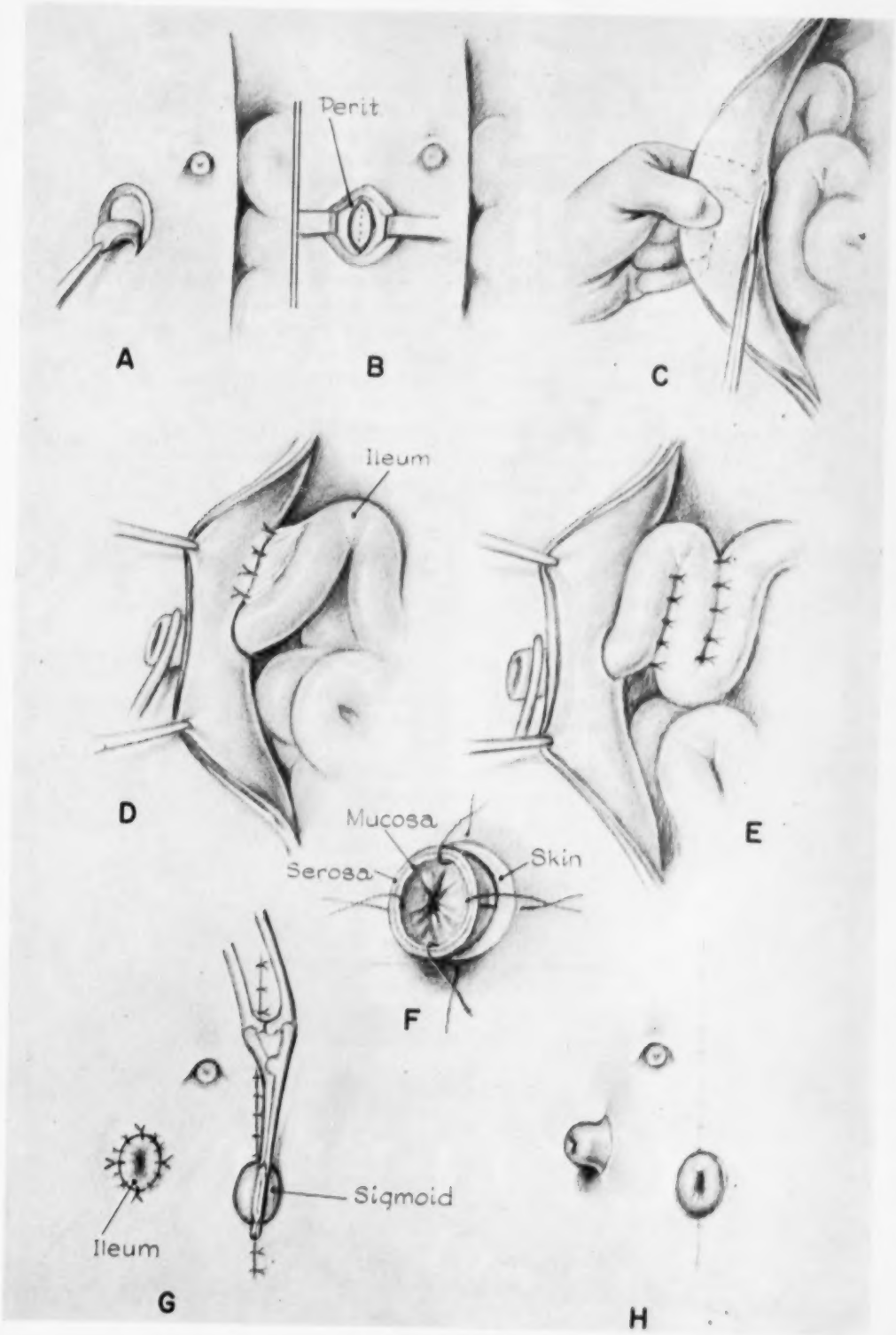
A,B,C, an opening is made into the peritoneal cavity after the removal of a wafer of skin, as advocated by Dennis to avoid scar contracture of the skin at the site of the ileostomy.

D, the attachment of the cut margin of the mesentery of the ileum to the anterior parietal peritoneum.

E, plication (Noble) of the terminal portion of the ileum recommended by Lichtenstein and Herzikoff for the prevention of ileal prolapse. Its use is also stressed by Garlock to prevent lower ileal obstruction.

F,G, the immediate suturing of the whole thickness of the wall of the ileostomy stoma to the skin margin. Prior to suturing, the terminal ileum projects approximately 4 cm. from the skin surface. Four cardinal sutures of silk (000) are first inserted (*F*) and held taut but not tied. In between these sutures a series of interrupted silk sutures are inserted to complete the eversion of the ileal stoma. This procedure, suggested by Mr. B. N. Brooke, of England, is used routinely to prevent stenosis and dysfunction of the ileostomy which frequently occurs following simple exteriorization with spontaneous eversion of the terminal ileum.

H, appearance of ileostomy and colostomy stomata five weeks postoperatively. One may note the spout-like projection of the terminal ileum at this stage compared with its flap appearance immediately postoperatively (*G*).


Perit
A
B
C
Ileum
D
E
Mucosa
Serosa
Skin
F
Sigmoid
Ileum
G
H

In the reexplorations of patients following ileostomy and either subtotal or total colectomy, I have been deeply impressed with the paucity of complications in those cases in which at the primary operation gentleness in the handling of tissues, meticulous hemostasis, the use of the finest and the least possible amount of suture material, and rigid adherence to strict aseptic surgical technique were practiced. If, in the performance of a colectomy, the utmost care is utilized to prevent drying, excoriation, or other trauma to the ileum, exploration at a later date reveals routinely the complete absence of any adhesions whatsoever in the abdominal cavity. The utilization, therefore, of the Noble plication technique (Plate VE) appears to me unnecessary. Leland S. McKittrick has emphasized that the development of enteritis above ileostomies that are properly prepared is almost never observed unless there is some obstruction at the ileostomy. In the reexplorations previously mentioned, the ileostomies which were considered truly satisfactory were only those in which the ileum just proximal to its passage through the abdominal wall was neither hypertrophied nor dilated.

The variance of these comments from the technique illustrated is an indication of the frequency with which a desired result may be obtained by a variety of successful maneuvers.

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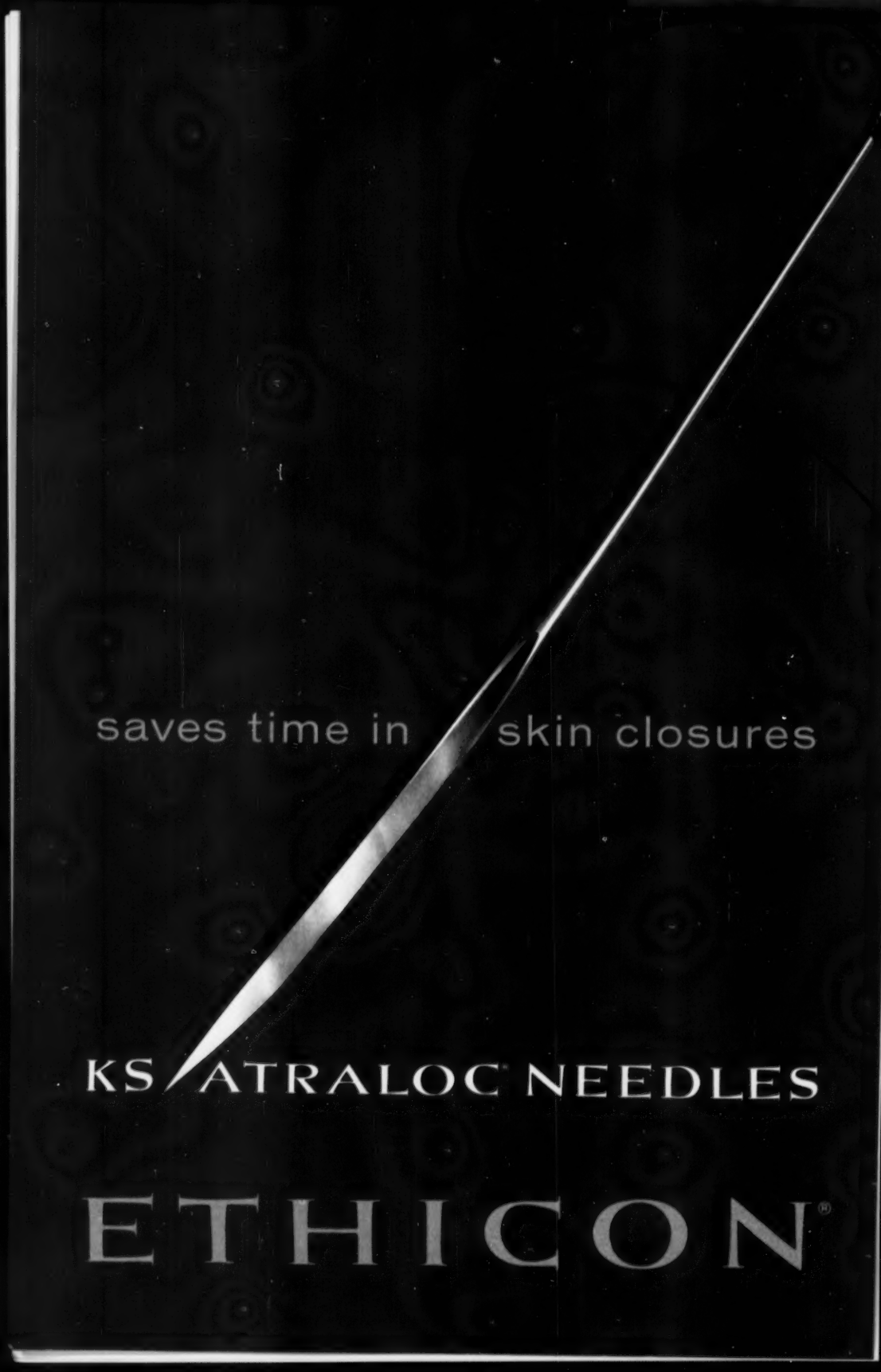
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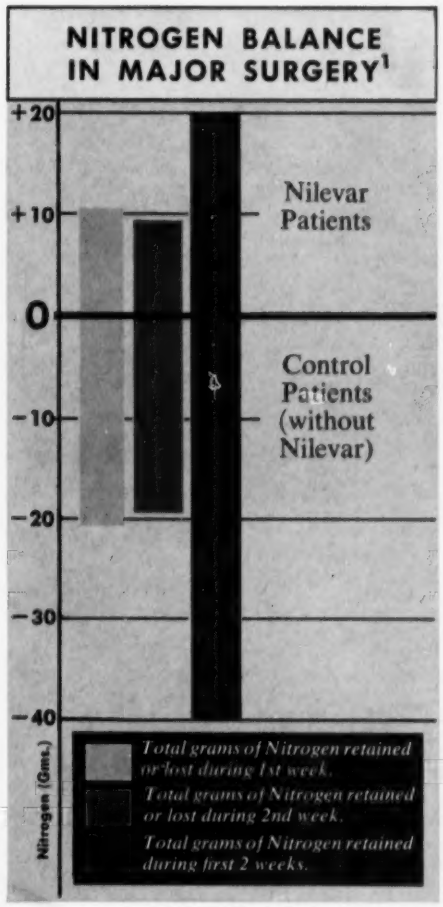

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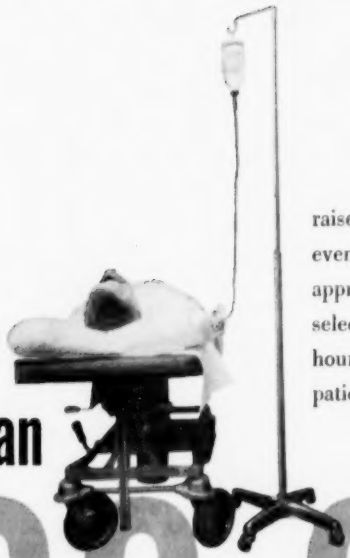

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